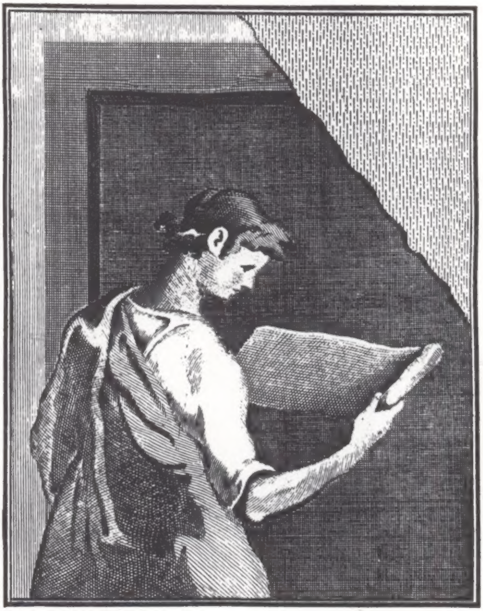

A

PRACTICAL TREATISE

ON THE

FABRICATION OF VOLATILE AND FAT VARNISHES,

LACQUERS, SICCATIVES, AND SEALING-WAXES.

FROM THE GERMAN OF

ERWIN ANDRES,

MANUFACTURER OF VARNISHES AND LACQUERS.

WITH ADDITIONS ON THE

MANUFACTURE AND APPLICATION OF VARNISHES, STAINS FOR WOOD, HORN, IVORY, BONE, AND LEATHER.

FROM THE GERMAN OF

DR. EMIL WINCKLER AND LOUIS E. ANDÉS.

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PUBLISHERS' PREFACE.

The entire absence of any treatise now in print in the English language, containing detailed descriptions of the raw materials and the apparatus and receipts for the preparation of Varnishes and Lacquers, and the great and pressing necessity for such a volume in this country and Great Britain, have been the considerations which have induced the publishers, who desire to cover with their technical publications all of the important branches of industry, to issue the Practical Treatise on the Fabrication of Volatile and Fat Varnishes, Lacquers, Siccatives, and Sealing-Waxes.

The work upon which it is mainly founded is that of Mr. Erwin Andres, which has met with great success in Germany, and which is thoroughly practical, and easily comprehended by the ordinary workman. It has also been enlarged by the addition of a number of receipts for the manufacture of Varnishes and Lacquers from various sources—thus bringing the

work up to the present date. Great care has been exercised in selecting these additional receipts, and only such have been given as have stood a practical test, and been recommended both by the manufacturer and the consumer. Most of the additional receipts have been adopted from Dr. E. Winckler and Louis E. Andés, both widely and favorably known, the first as an eminent chemical technologist, and the other as a practical manufacturer of varnishes, who received, at the Vienna Exposition of 1873, the great silver medal for his Report on Varnishes.

The book has been still further enlarged by the addition of a Treatise on the Art of Varnishing, also from Dr. Winckler and Mr. Andés, included in which will be found a large number of valuable receipts for stains for wood, bone, and ivory, and putties, etc., which must prove of great interest to the practical man.

The whole has been translated and edited by Mr. Brannt with especial care, and with a view to its utility in actual practice, and it is believed that it cannot fail to meet with the approval of the large body of Manufacturers, Mechanics, Artisans, and Artists for whom it is especially intended.

PHILADELPHIA, June 5, 1882.

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PRACTICAL TREATISE

ON THE

FABRICATION OF VARNISHES, LACQUERS, ETC.

I.

INTRODUCTION.

By lacquers and varnishes we understand fluids which, in a short time after they have been laid on an article, undergo such a change as to leave a colorless, or, at least, only faintly colored coating behind; though, of course, there are varnishes which have been colored intentionally. This coating has a smooth, glossy surface, and serves either for embellishing the article thus coated, or for protecting it against outward influences.

A good lacquer or varnish, when once applied, should dry quickly, and form a uniform layer of considerable thickness and bright lustre; it should preserve these properties for a long time, should neither break nor crack, and should possess sufficient elasticity to allow the varnished or lacquered article (for

instance, wood or leather) to be bent to a certain extent without cracking the coating.

The old civilized races of Eastern Asia, the Hindus, Chinese, but particularly the Japanese, are masters of the art of manufacturing varnishes and lacquers. Especially the last-named nation occupies such a high rank in this art, that, speaking without prejudice, we must admit that in this respect they are far in advance of us. We have seen Japanese lacquer-work at the International Exhibition at Vienna, in 1873, and a still larger display in Paris in 1878, which, on account of the excellent quality of the lacquer, attracted the attention of all judges of such things.

But it is by no means our opinion that these nations surpass the Europeans in chemical knowledge of the manufacture of lacquers and varnishes; just the reverse, in this respect we may be rather their teachers, but next to the conscientious labor which marks all Japanese work, we attribute the excellent quality of their products to the raw materials they use. They have at their command oils and resins furnished to them from the rich treasury of vegetable products of the tropics, materials, many of which we do not know at all, but which seem to be especially adapted for the fabrication of varnishes and lacquers. We believe we do not speak erroneously when we express the opinion that the stock of materials for the manufacture of lacquers and varnishes will be substantially increased before long from Japan, as it is well known that at the

present time the country is being opened up more and more to the Europeans.

We know of few products of the chemical industry which find such universal use as lacquers and varnishes. They are absolutely indispensable to the mechanic as well as to the artist. We only need call to mind that the wood of our floors and furniture, many articles of leather, our carriages, the component parts of iron bridges, and other articles of metal exposed to the weather, are varnished or lacquered for the purpose of giving them a pleasing appearance or to protect them against the weather; we would further remind the reader that the painter, the gilder, the mechanic, the photographer, in short all those engaged in the art of manifolding articles require varnish or lacquer in one form or another for their purposes.

In the following pages we have endeavored to describe the fabrication of all kinds of varnishes and lacquers in such a manner as to be easily understood by all. Whatever chemical processes are treated of, we have explained the nature of these processes in such a way that even those who have received no instruction in this highly important science can easily comprehend it.

As varnishes and lacquers and the substance to which the name of sealing lacquer has been given, are closely related to each other, and as both industries can be very well carried on together, we have added to this work a treatise on the fabrication of the different kinds of sealing lacquer and sealing wax.

Classification of Lacquers and Varnishes.

We cannot draw a sharp line of distinction between varnishes and lacquers. By varnishes we generally understand certain fat oils which, by proper chemical treatment, have acquired the property of hardening in a short time to a transparent mass when they are exposed to the air in thin layers. The term lacquer is generally given to solutions of different kinds of gum or resin, dissolved in proper solvents, and when these become hard when exposed to the air, the dissolved resin is either held inclosed by the solvents or the latter simply evaporate and leave the dissolved substance behind.

As the first group of lacquers is prepared with fat oils, they are called fat or oil varnishes. The oil varnishes are without doubt the most valuable products of our branch of industry, because, besides possessing considerable hardness and bright lustre, they are more durable and possess a greater power of resistance than other kinds of lacquers or varnishes.

Those kinds of lacquer in which the gum or resin is dissolved by a volatile solvent are usually called spirit varnishes, because formerly, besides oil of turpentine, spirit of wine was exclusively used as a solvent. But, as in the present state of our industry this term is no longer a proper one, we consider it necessary to designate these kinds of lacquers as volatile lacquers. Besides ethylic alcohol (spirit of wine or alcohol in com-

mon language) methylic alcohol (wood-spirit), benzine, petroleum, naphtha, and many other volatile substances are used as solvents.

According to what has already been said, we may divide varnishes and lacquers into several groups, namely:—

1. *Fat oil varnishes* obtained by a chemical change of certain oils of vegetable origin, the so-called drying oils.

2. *Fat or oil lacquers* obtained by dissolving different kinds of gum or resin in the above named fat drying oils.

3. *Volatile lacquers or varnishes*, prepared by dissolving different kinds of gum in volatile fluids, such as oil of turpentine, ethylic alcohol, methylic alcohol, ethylic ether, benzine (by benzol or benzine we understand certain volatile fluids which are obtained by distilling coal tar, and the terms benzol or benzine are to be understood in this sense in the following pages), and naphtha.

Although it is absolutely necessary that every manufacturer should have a thorough knowledge of the raw materials used in his branch of industry, yet for two reasons this seems to be doubly necessary for the manufacturer of lacquers and varnishes; for, on the one hand, the quality of the products depends in a higher degree on the choice of the proper raw materials than is the case in any other industry; and, on the other, because the elementary materials we have

to use are frequently brought into the market adulterated in an almost incredible manner.

In view of the last-named circumstance we would advise every manufacturer to procure the necessary chemicals from well known manufacturers only, and to buy the raw materials from firms of good standing, but especially the foreign gums and resins, as they are very frequently adulterated on account of their costliness.

But as it is always of the utmost importance for every one to be able to form for himself a decisive judgment as to the quality of the raw products, we have briefly mentioned in the following chapter of this work, which treats of the raw materials, the physical and chemical characters of all the materials, and in doing this we believe we have rendered a service to every manufacturer.

II.

RAW MATERIALS, USED IN THE FABRICATION OF LACQUERS AND VARNISHES.

THE raw materials used in our industry are so numerous that we must endeavor to find some practical classification. First, the nature of the materials themselves furnishes such a classification, namely, fluid and solid raw materials. The fluid raw materials are either non-volatile or volatile; the solid raw materials are

either natural products or products of chemical industry.

Using this as a basis of our classification we can now proceed to a description of the different raw materials.

Fluid Raw Materials.

A.—*Non-volatile.*

Fat, Non-drying Oils.

Of these the following are used in the manufacture of lacquers and varnishes: hemp oil, pumpkin oil, linseed oil, grape-seed oil, poppy oil, nut oil, and castor oil. But only a few of those mentioned are used to any large extent, and linseed oil occupies the foremost place in this respect.

B.—*Volatile.*

Essential Oils and Chemical Products.

Acetone, ether, camphor, benzol, wood spirit, petroleum, naphtha, sulphuret of carbon, oil of turpentine, tar oil, spirit of wine.

Solid Raw Materials.

A.—*Natural Products.*

Gums and Resins, Wax.

The numerous substances belonging to this group are mostly of vegetable origin, though some of them

are also derived from the mineral kingdom, and only one from the animal kingdom. The following are of special importance :—

Asphaltum, amber, benzoin, colophony, capal, dammar, elemi, gutta percha, caoutchouc, mastic, sandarac, shellac, turpentine, wax.

Pigments.—Coloring Matter.

Aniline colors, turmeric, curcuma, dragon's blood, gamboge, indigo, lampblack, seed lac, saffron, sanders wood.

B.—*Chemical Products.*

Compounds of lead: protoxide of lead (litharge), acetate of lead (sugar of lead), red oxide (red lead, or minium). Compounds of manganese: pyrolusite (peroxide of manganese), permanganate of potassium, borate of manganese, etc. Compound of zinc: oxide of zinc (flowers of zinc, or zinc-white). Mineral tar oil, refined paraffin, hard caoutchouc.

III.

DRYING OILS.

In conformity with their chemical properties, the drying oils must be classed with the large group of combinations known under the general term of fats. But as the drying oils form the basis of the fabrication

of lacquers and varnishes, we consider it necessary to devote a somewhat larger space to the explanation of these bodies, so as to give those who possess no chemical knowledge an insight into those points to which special attention has to be paid in our branch of industry.

Fats in general are combinations consisting, as far as their combinations are concerned, of a so-called base and several acids. As chemists designate combinations of a base and acids by the general term of salts, we may say: fats are salts containing several acids. The base of most fats, and also of drying oils, is an oily body, having a pungent, sweetish taste. This, in a refined form, is found in commerce, as a much used toilet article, under the name of glycerine. Generally three acids are found in fats, namely: stearic acid, palmitic acid, and oleic acid; the first two of these form the material from which the so-called stearin candles are manufactured. In their purest state they represent foliated, colorless crystals, which melt only at a temperature of over 60° C. (140° F.). Oleic acid is always an oily, thick, mostly yellowish colored fluid, of a strongly acid character, and is used for cleansing metals, but especially for manufacturing soap.

Most fats, therefore, consist of combinations of glycerine with stearic, palmitic, and oleic acid. These combinations are called glycerides, and, according to the predominance of tristearin, tripalmitin, or triolein

in these combinations, the fats are divided into tallow, butter, and lard (fixed fats), and into oils (fluid fats).

When any one of these fats is exposed to the air for any length of time, it undergoes a considerable change in regard to its properties: the formerly colorless and tasteless mass acquires a very disagreeable odor, and strongly acid taste; at the same time it assumes a darker color, and the formerly fluid fats become viscid. This change in the fats produced by a certain component part of the air (fats from which the air is entirely excluded do not undergo such a change) is called rancidity. But we would draw special attention to the fact that a fluid fat *always remains fluid; it may become more viscid, but it never congeals to a solid mass*, even if it is exposed for years to the influence of the atmosphere. It is this property which forms the only actually recognizable boundary line between the drying and non-drying oils; as the drying oils possess the property of changing under the influence of the air in a short time into solid masses having a resinous appearance.

In many oils this change takes place in a few hours, especially when the oil is brought in contact with a large quantity of oxygen, that is, when it is exposed to the air in a very thin layer. Such oils are classed as good drying oils, and are especially adapted for the fabrication of lacquers and varnishes. But, on the other hand, those oils requiring days, weeks, or even months for drying in, are called bad drying oils, and

the longer the time they require for drying in the less value they possess for our purposes.

The process of drying in does not take place in such a manner that the oil congeals to a hard mass at a certain moment, but by coming in contact with the air it thickens more and more, and gradually passes from a fluid into a solid state. But as of course this transformation also takes place when drying oils are exposed in an open vessel to the influence of the air for any length of time (but the vessel should be protected from dust falling into it by a frame covered with blotting-paper), thus already introducing the drying process into the oil, this will explain the reason why, for instance, old linseed oil is dearer than that which has been pressed recently. The first by having been in contact with the air for a considerable time has been already transformed to such an extent that, when it is spread out in a thin layer in this condition, it may be actually called a kind of varnish, as in a very short time it will form a solid, coherent mass ; but the latter must be either stored for a long time, or has to undergo a special treatment to acquire the property of drying quickly.

There are certain bodies of the nature of acids which give to the drying oils the property of solidifying into hard masses. One of these acids which has been examined and studied most thoroughly is the one found in linseed oil, the so-called linoleic acid. Now as linseed oil is the most important of all drying oils, we may take it as a sample of drying oils, and from

its behavior study that of all others, and what will here be said about the changes linseed oil undergoes when exposed to atmospheric influence, holds good almost to the letter in regard to all other genuine drying oils.

When linseed oil is exposed to the air in a vessel protected against the falling in of dust, we perceive that the oil undergoes a gradual change as far as its physical qualities are concerned; it assumes a darker color, becomes more viscid and less inflammable. At the same time a steadily progressing increase of weight will be noticed, which, according to our special experiments, made as to this subject for a year and a half, may amount to fully 8 per cent. An experiment made for this purpose with 100 grammes (3.5 ozs. avoird.) of the best Bavarian linseed oil gave an increase of weight of 8.98 grammes (0.31 oz. avoird.) after the oil had been exposed to the air for eighteen months.

All the drying oils consist of combinations in which are contained the elementary bodies: Carbon C,[1] hydrogen H, and oxygen O. Now accurate experiments have shown that the drying oils absorb a large quantity of oxygen from the air, and in return liberate a certain quantity of carbonic acid (CO_2) and water (H_2O) in the form of vapor; the carbon C, and hydrogen H, originate from the oil, the oxygen from the

[1] The added letters are symbols used in chemistry for representing these elementary bodies.

air. The origination of every combination of any elementary body with oxygen is called in chemistry combustion or oxidation. In one part of the components of the drying oils oxidation progresses so far that no more oxygen can be absorbed, they are completely oxidized to carbonic acid and water, which escape into the air; in another part oxidation progresses only so far as to form combinations which contain a larger amount of oxygen than those which were previously present, and, therefore, become more viscid.

According to what has been said above, the changes the drying oils suffer from a continued contact with oxygen, can be briefly expressed as follows:—

The drying oils absorb from the air a quantity of oxygen amounting to as much as 8 *per cent. of the weight of the oil, which completely oxidizes a part of the carbon and hydrogen contained in the oils, to carbonic acid and water, and with the remaining components produces viscid combinations, which finally become solid by a still further progressing absorption of oxygen.*

It is a well-known fact that differently colored light produces chemical effects of different powers. Now, comparative experiments have proven that an entire absence of light is a most unfavorable condition for the absorption of oxygen, but that a green light is the most favorable. It would, therefore, appear to be advisable to keep linseed oil, not in barrels, but in bottles of common green glass.

As will be explained more fully later on, it is possible to accelerate the absorption ot oxygen by the drying oils by using certain chemicals, and it is this operation which is actually carried on in boiling the varnish. According to the investigations of excellent chemists, it is not actually necessary to boil the drying oils for them to acquire the property of drying quickly, that is to change into varnish.

It is a well-known fact that the fat oils, the unctuous non-drying, as well as the drying oils, are usually gained by subjecting the vegetable parts in which they are found to a strong pressure. In consequence of the very high pressure used for this purpose, many other substances, such as vegetable fibres, vegetable gum, and vegetable albumen, become mixed with the oil, which have to be removed by so-called refining.

Refining is generally done by treating the raw oil with sulphuric acid, which does not change the oil but destroys all other substances which are separated in a carbonous mass, and give a black color to the oil. After the oil has become clear it is drawn off from the sediment, and freed from the adhering sulphuric acid by treating it with water. According as the refining process has been carried on with more or less care, the oil will contain fewer or more foreign substances. But it is just these foreign substances which injure the power of the oils to dry quickly when exposed to the air, and it has, therefore, been proposed to treat the oils with substances dissolved in water, which possess

the property of forming insoluble, quickly separating combinations with the above-named bodies (vegetable gum and vegetable albumen). Linseed oil refined in this manner did in fact dry to a perfectly solid mass in thirty hours after it had been applied on a glass plate. In speaking of linseed oil we will return to this important phenomenon.

Linseed Oil.

Linseed oil is obtained from the seed of the flax (*Linum usitatissimum*), which is raised in large quantities, especially in the more temperate countries of Europe. The seed contains more than 28 per cent. of oil, but at the utmost only 26 to 27 per cent. can be gained. Fine linseed oil is always obtained by pressing it at an ordinary temperature—cold pressing; by heating the pressed mass to the boiling point of water—hot pressing—a larger percentage of oil can be obtained, but it is always inferior in quality to the cold-pressed oil.

Cold-pressed linseed oil has a very light-yellow color, very little but a peculiar taste and odor; the hot-pressed oil has a much darker color, golden yellow to amber, and the peculiar taste and odor of the oil are much stronger and more disagreeable.

Good linseed oil should always be of light-yellow color, should have but little odor, and when rubbed upon a glass plate should feel sticky to the touch within a few hours.

The lighter the color of a varnish or lacquer is, the

more valuable is the product, but no colorless varnish can be manufactured with ordinary linseed oil, be its color never so light a yellow. But it is possible to bleach the linseed oil by various processes in such a manner that it represents a perfectly colorless fluid clear as water.

Bleaching of Linseed Oil.

Bleaching with a solution of Green Vitriol.—10 kilogrammes (22 lbs.) of the oil to be bleached are placed in bottles holding from 15 to 16 liters (4 to 4.2 gals.), and 4 to 5 liters (4.2 to 5.2 quarts) of a solution of green vitriöl are added to every quantity of oil. The solution of green vitriol is prepared by dissolving 100 kilogrammes (220 lbs.) of green vitriol in 160 liters (42.2 gals.) rain water. The bottles are placed in a light room in such a manner that they are exposed as much and as long as possible to the direct rays of the sun. Every bottle should be well shaken at least once a day. It takes from three to six weeks to perfectly bleach the oil. The length of time will depend on the temperature, but especially on the stronger or weaker effect of the rays of the sun. The clear oil is then poured off carefully from the solution of green vitriol, and kept in glass bottles. The solution of green vitriol can be used several times for the same purpose. Should it have lost somewhat of its strength, it can be made effective again by adding 10 kilogrammes of green vitriol to 100 liters (26.4 gals.) of the fluid.

Bleaching with sulphuric acid is done in a similar manner to that which has been explained in refining the oils in general, but the oil is not washed sufficiently to remove every trace of sulphuric acid, as lead colors prepared with such linseed oil offer a greater resistance to the after-darkening than such as have been prepared with oil entirely free from acid.

Bleaching with Sulphate of Lead.—Sulphate of lead is a white, insoluble powder, which can easily be prepared by a combination of sulphuric acid with acetate of lead (sugar of lead). For the purpose of bleaching linseed oil with this preparation, two per cent. of the mass of oil is taken and rubbed intimately together with a little oil upon the grinding-stone. This mixture is then thinned down to the consistency of milk and added to the linseed oil which in this case must also be placed in bottles exposed to the light. The turbid fluid clarifies slowly, and in a few weeks the oil will be found perfectly clear and bleached. The foreign substances which were contained in the oil lie in a tolerably solid skin-like mass over the sediment of sulphate of lead, which can be used quite often for the same purpose.

On account of its great commercial value linseed oil is frequently adulterated. When oils of less value are added, it is very difficult to detect such an adulteration, and it can only be discovered by an accurate determination of the density. It is easier to detect an addition of common resin with which the oil is frequently adulterated. To detect such an adulteration

the oil is shaken with a double quantity of strong spirit of wine, which dissolves the resins but the oil does not mix with it. If a few drops of a solution of acetate of lead are added to this solution, a strong flocky precipitate will be formed at once, if resin should be present in the oil. If the fluid remains clear after the solution of acetate of lead has been added, it is a proof that no resin is contained in the oil.

Hemp Oil

is gained by cold and hot pressing from the seeds of the hemp plant (*Cannabis sativa*). It has a light yellowish-green color, but only as long as it is fresh; old oil becomes gradually darker, and finally assumes a dull-brown color. Generally hemp oil does not dry as well as linseed oil, but it can be very well used for varnishes, especially for those purposes where its dark color will be no hindrance.

Poppy Oil

is obtained in considerable quantities from the small, black seed of the common poppy plant (*Papaver somniferum*). The seeds are so rich in oil that more than one-half their weight can be gained from them. Poppy oil has a light-yellow color, and on account of its mild, agreeable taste, is frequently used for culinary purposes. In the fabrication of lacquers and varnishes it is only used for fine qualities. It is also used by artists for thinning their colors.

Nut Oil.

This oil is obtained from the fruit of the common walnut tree (*Juglans regia*). The cold-pressed oil differs essentially from that which is obtained later on by using heat. The first is nearly colorless, or at least only slightly yellowish-green, and when fresh has a very pleasant odor and taste; when exposed to the light it becomes perfectly bleached in a short time. Hot-pressed oil is highly colored, and has a rather disagreeable taste and odor. For this reason hydraulic presses are only used for pressing the oil, as these produce the greatest pressure of all presses. As cold-pressed oil commands a higher price, the manufacturers endeavor to obtain the highest pressure by the most powerful presses, so as to be able to gain the greatest part of the oil by cold pressing.

On account of its very light color it is much liked for the fabrication of very fine varnishes, and also for thinning colors used in oil painting.

Other Drying Oils

are grape-seed oil, cotton-seed oil, pumpkin oil, etc., but so far they have been generally but little used, and are scarcely known at all in the fabrication of varnishes. But as the oils mentioned above can be produced in large quantities and at very low prices, we have made experiments with them, as, if they are properly treated, they furnish very well drying varnishes. As the bleaching of these oils is a very tedious

labor, it seems to us advisable to use them for such varnishes as do not require to be of a very light color. In consequence of the continual rise in the prices of oils, it seems to us very important to call attention to these oils, as by using them the manufacturer will be enabled to place in the market products of the second and third qualities at a very low price.

Grape-seed oil and cotton-seed oil would be especially suitable for such use as raw materials, for the seeds are almost of no value whatever to the wine grower and cotton planter, and would be sold at a low price, and the principal expense in manufacturing the oil would be the wages for pressing the oil.

Adulterations of Drying Oils.

The great commercial value of drying oils induces many to adulterate these products. The adulterations consist principally, as we have mentioned already in speaking of linseed oil, in adding resin or a less valuable oil to one of greater value. Unfortunately, it is very difficult to detect the last-named adulterations on account of the great similarity of the action of all drying oils. But there are some means by which such an adulteration can be detected with tolerable accuracy. These consist in ascertaining the specific weight or density by an accurate areometer, and the testing of the oils with sulphuric acid and nitro-muriatic acid or aqua regia (a mixture of nitric acid and hydrochloric acid) and soda.

Below we give a little table which will furnish the

necessary points for ascertaining the density, but we must remark here that these densities are only correct for 15° C. (59° F.), and that this must be exactly the temperature of the oil to be examined. The drying oils possess also the property that they only solidify at a very low temperature, and we have mentioned the degrees at which they solidify, as these may also be used in examining an oil in regard to its purity.

Name of the oil.	Density at 15° C., 59° F.	Becomes viscous at		Solidifies at	
Linseed oil ...	0.9348	—16°C.	+3.2°F.	—27°C.	—16.6°F.
Nut oil	0.9261 / 0.9268	—18	—0.4	—27	—16.6
Poppy oil.....	0.9242 / 0.9250	—18	—0.4	—20	— 4
Hemp oil.	0.9276	—16	+3.2	—28	—18.4
Castor oil.....	0.9611	—16	+3.2	—17	+ 1.4
Grape-seed oil.	0.9202	—15	+5.0	—17	+ 1.4
Cotton-seed oil	0.9310 / 0.9322		?		?

The two numbers (in brackets) opposite to those oils having a varying desity indicate the utmost limits ever observed in them.

Testing with acids is done by placing a certain quantity of the oil and the acid upon a white porcelain plate, and by observing the changes in the color. The concentration and density of the acid exert in this respect a strong influence upon the appearance of the colors. We always use sulphuric acid having a density of 1.638, and nitro-muriatic acid, or aqua regia, composed of twenty-four volumes of hydrochloric acid

having a density of 1.156, and one volume of nitric acid having a density of 1.333, and finally, the caustic soda solution has a density of 1.350. For five volumes of oil we use one volume of the acids and ten volumes of the caustic soda solution, which are added to the oil after it has been compounded with the nitro-muriatic acid. According to our experiments the following changes of color will appear in from four to six minutes after the test fluid has been added to the oil. The acid is allowed to drop upon the oil, and the color appearing on the edge of both is observed; in about six to seven minutes the two fluids are stirred together, and the appearing change of color is again observed.

In the following we mention a few tests we have obtained from oil pressed by ourselves, and we would advise all buyers of drying oils always to procure small quantities of undoubtedly genuine oil, so as to be able to examine the genuine oil along with the oils to be tested, and to compare the color phenomena.

Name of the oil.	Tested with sulphuric acid becomes	With nitro-muriatic acid and later with caustic soda solution becomes
Linseed oil..	Green	Yellowish-green; orange (remains fluid).
Nut oil	Brown	Yellow; fibrous orange.
Hemp oil ...	Dark brown	Green; fibrous light brown.
Castor oil...	Yellow	Yellow; fibrous light red.

IV.

VOLATILE FLUIDS USED IN THE FABRICATION OF VARNISHES.

Besides the drying oils only the essential oil of turpentine and spirit of wine were formerly used in the fabrication of varnishes, but in modern times the number of those volatile fluids which may be used as solvents, for various resins, has largely increased, and without doubt the number of these substances will be still more augmented by the progress of science, as every quickly volatilizing body, possessing the power of dissolving resins, may be used as a solvent for them. According as the boiling point of these fluids is high or low the varnishes or lacquers will dry quicker or slower, and in this respect we have already advanced so far as to be able to produce lacquers which are prepared with such volatile solvents that they will solidify in a few seconds after they have been applied to a surface, and in most cases they have to be mixed with some other less volatile fluid to prevent them from drying too quickly.

The volatile fluids are not only used for preparing certain lacquers and varnishes, but they are also much employed for sufficiently thinning the viscous, fat lacquers. Some of these bodies are natural products, but most of them belong to those substances which can

only be obtained by certain chemical processes. We shall describe these fluids in the order as they appear to be of most importance for our purposes.

Oil of Turpentine.

The term oil is not well adapted for this substance, as these substances have nothing further in common with oils than that they produce a transparent stain upon paper, but as the oil evaporates this after a short time disappears again. The essential oils to which the oil of turpentine belongs, and with which we may also class petroleum (rock oil), as well as the so-called tar oils, consist of carbon and hydrogen only. When exposed to the air they partly volatilize and partly absorb oxygen from the air, become viscous, and finally, solidify; they change into resins. The fluid oil of turpentine is pure hydrocarbon, whereas colophony is the oil of turpentine completely changed into resin, the half soft turpentine is an intermediate substance.

The oil of turpentine exudes from the partly barked trunks of the coniferæ, and especially the fir, pine, and larch are used for this purpose. The oil partly changed into resin is collected and treated in distilling apparatuses, where the oil of turpentine is separated in an unchanged state from the colophony-pitch which remains in the distilling vessel. The oil of turpentine is refined by repeated distilling, the so-called rectifying.

Perfectly pure oil of turpentine—the Austrian and

French oils are of an excellent quality—is a fluid clear as water, possessing a not disagreeable but overpowering smell. It reflects light very strongly, has a density of from 0.850 to 0.890, and its boiling point lies between 160° and 180° C. (320° and 356° F.). Notwithstanding this very high boiling point, oil of turpentine is very volatile at an ordinary temperature, and must be kept in tightly closed bottles, and a room where much oil of turpentine is stored should not be entered with a lighted candle, as the air impregnated with inflammable vapors might catch fire from the flame and an explosion take place.

When oil of turpentine is inclosed with a large quantity of air in a spacious vessel it becomes viscid by absorbing oxygen, and acquires by this means an extraordinary bleaching power. We have successfully used such oil of turpentine for bleaching fat drying oils with which it is miscible in any proportion. The most important property of oil of turpentine for our purposes is the great solving power it possesses over resins. It will dissolve the larger part of the resins and leave them behind in evaporating.

Camphor.

Although a solid substance, yet, according to all its properties, camphor belongs to the essential oils. Camphor is obtained from a tree belonging to the laurel family which is found in the southern parts of Eastern Asia, and in whose wood the camphor is stored as a white crystalline mass. The refined

(sublimated) camphor forms white crystalline masses resembling alabaster in appearance, has a peculiar strong smell, melts at 151° C. (303.8° F.), boils at 163° C. (325.4° F.), and can be easily dissolved in spirit of wine, ether, volatile and fat oils. When set on fire, camphor burns with a white flame, depositing considerable quantities of soot.

Petroleum and Petroleum-naphtha.

For about fifteen years immense quantities of rock oil (petroleum) have been imported into Europe from the United States, and it has gradually taken the place of fat oils for illuminating purposes. The composition and properties of petroleum correspond generally to those of oil of turpentine. Petroleum also possesses the power of dissolving resins and of leaving them behind in evaporating. The extraordinarily low price at which this article is brought into commerce causes it to be well adapted as a partial substitute for the considerably dearer oil of turpentine, and experiments have proven that *refined* petroleum can be advantageously used instead of oil of turpentine for thinning thick fat varnishes.

In refining petroleum, several *extraordinarily volatile hydrocarbons are obtained which are excellent solvents for resins*, and for this reason deserve great attention from manufacturers of varnishes. In commerce these substances are found as fluids clear as water, and are known as kerosene, petroleum-naphtha, and benzol (benzine). Large quantities of the latter

are also manufactured from coal-tar. As the boiling point of most of these fluids is below 60° C. (140° F.), they must be kept in well-closed vessels, and, on account of their inflammability, the greatest care with fire and light is required. Resins are quickly and easily dissolved in these oils, but the solutions dry already under the brush, and when used must therefore be thinned with petroleum, oil of turpentine, or spirit of wine.

Tar Oils.

Thick, mostly very strong smelling fluids known as tar are gained by dry distillation, that is, by heating organic bodies (such as wood, stone-coal, and brown coal) in a vacuum. Several solid and fluid products consisting also of combinations of hydrocarbons, and which are principally used for illuminating purposes, are obtained by distilling the tar. The lighter and volatile products of this are fluid, are less valuable for illuminating purposes, but are especially well adapted for dissolving resins, and are much used for this purpose. In regard to their properties, the same holds good that has been said about petroleum naphtha and benzol.

In commerce a distinction is made between light and heavy tar oils. The first are less dense and their boiling point is lower than the latter, and they are principally used for manufacturing volatile varnishes and lacquers.

Wood-spirit,

or methyl-alcohol, is gained in large quantities by a dry distillation of wood. It is a colorless fluid having a strong odor and poisonous properties, boils at 66° C. (150.8° F.), is very inflammable, and burns with a colorless flame. It can be mixed in any desired proportion with oil of turpentine, spirit of wine, and the tar oils. It easily dissolves resins, and can be used instead of the expensive spirit of wine for making volatile varnishes, which also dry quicker than pure spirit of wine varnishes. Methyl-alcohol, either by itself or mixed with other volatile solvents, has already for a long time been used in England for the manufacture of excellent varnishes.

Spirit of Wine,

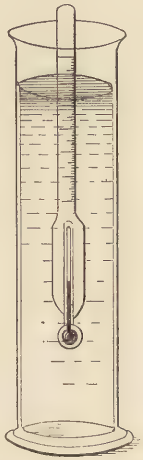
also called ethylic alcohol, spirit, or simply alcohol, is formed by the so-called vinous fermentation of sugar, and is found in a diluted state in all spirituous beverages, such as beer, wine, or whiskey. Pure spirit of wine is a colorless, thin fluid having a density of 0.7939. It boils at 78.4° C. (173.1 F.), and possesses poisonous properties. But spirit of wine is never brought into commerce in its pure (free from water) state, but contains always a certain quantity of water. In commerce it is customary to designate the quantity of pure alcohol contained in a fluid by per cents. or degrees ; spirit of wine of 90 per cent. or 90

degrees contains in 100 parts 90 parts of pure alcohol and 10 parts of water.

Spirit of wine easily dissolves all resins, but only when it contains but a small percentage of water. The stronger the spirit of wine is, the better it seems to be adapted for use in the fabrication of varnishes, and the manufacturer should never use spirit of wine containing less than 90 per cent. of pure alcohol.

The percentage is generally guaranteed by the manufacturer, but it can be easily ascertained by using the so-called Tralles alcoholometer (Fig. 1).

Fig. 1.



The number to which the instrument sinks into the fluid indicates at once how many per cents. of pure alcohol are contained in the fluid.

Ether.

Ethylic ether, sometimes called in commerce (but wrongly) sulphuric ether, is obtained by distilling spirit of wine with sulphuric acid; hence the name sulphuric ether. It is a fluid having a penetrating and over-powering smell, and a density of 0.736; it boils at 34.5° C. (94.1 F.°), is very inflammable, and is miscible in any proportion with spirit of wine. Ether dissolves resins very easily, but varnishes prepared with it must always be thinned with spirit of wine, as they dry almost immediately on account of the low boiling point of the solvent. Ether vapors, like those of benzol and petroleum naphtha, form a very explosive compound when mixed with air, and for this reason all fire or light must be carefully kept out of the room when these substances are used.

Aceton,

or pyroacetic spirit, is obtained by a dry distillation of acid salts. In a pure state it is a colorless, thin fluid, having a density of 0.814, and boils at a temperature of 56° C. (132.8° F.). Acetone dissolves resins, can be mixed in all proportions with other solvents of resins. As it is of greater service than other solvents, and commands a rather high price, I would not recommend the use of acetone to manufacturers, though chemists have proposed it as a solvent, as there are a number of other and cheaper solvents which perform the same service.

Bisulphide of Carbon (Alcohol Sulphuris).

This body is obtained by a combustion of carbon in sulphuric vapor, and by introducing the formed vapors into a vessel filled with ice. It is a colorless fluid, refracting light strongly, has a peculiar, disagreeable odor, resembling that of radishes, is very inflammable, of great density, and boils at a temperature of 43° C. (109.4° F.). As bisulphide of carbon is very volatile, it must be stored under water. It is very cheap, and as it possesses the property of very easily dissolving resins, caoutchouc, etc., it is very frequently used as an excellent solvent for resins.

It is evident that the cheaper the solvent is the less will be the cost of preparing varnishes, in this respect bisulphide of carbon seems to deserve special attention, and it is now brought into the market by many manufacturers in a perfectly pure state, and at a very low price. On account of its possessing a considerable power of dissolving fat oils, it is also very well adapted for gaining them from vegetable parts. Impure bisulphide of carbon, that is, such as holds but small quantities of free sulphur in solution, is not very suitable for the manufacture of lacquers, as they will show but little gloss when they have become dry; and for this reason an entirely pure article should be used only.

V.

VARIETIES OF GUMS AND RESINS.

GUMS are non-crystalline substances, which flow from different species of plants when their bark has been injured, and which solidify to glassy masses when exposed to the air. The well-known so-called gum arabic—which is much used as a paste—may serve as a representative of these bodies. But frequently the gum is mixed with other substances originating from the same plant, and often masses are found containing gum, resins, coloring matter, and sometimes tannin and other combinations. The gum and resin from cherry-trees is such a mixed substance. Such masses are called gum resins to distinguish them from the pure resins, which are always solid and hard, as, for instance, colophony. To be sure, there are also resins which can be kneaded at an ordinary temperature, and are therefore called soft resins; but we must reject this term as incorrect, as the so-called soft resins are only of a soft consistency, on account of essential oils adhering to them. Many soft resins approach closely to the so-called balsams, which are half-fluid, and owe this condition to the great quantity of essential oil they contain. When these balsams are exposed for any length of time to the air they gradually gain greater

consistency, resemble more closely the soft resins, and, finally, change into entirely solid or hard resin.

The vegetable resins are found either ready formed in certain parts of the plants, or they are held in solution by an essential oil, and flow in a more or less thick mass from incisions made in the bark of the plants, or they are mixed with the milky juices, solidify in combination with them, and then form the gum resins.

Among the European plants the different species of Coniferæ produce the largest quantity of resin. But a large number of plant-families are found in the tropics, which produce various resins in immense quantities. We have already mentioned on a former page that it is very likely we do not even yet know many of these resins, which would be especially adapted for the manufacture of lacquers, and are very likely already used for this purpose.

Besides the resins originating from the vegetable kingdom, two other resins, which are found in the earth, are used in the fabrication of lacquers and varnishes. These are designated as fossil or mineral resins, though they originate from the vegetable kingdom, or, at least, amber certainly does. In regard to the other fossil resin, asphaltum, no definite conclusion, in regard to its origin, has yet been arrived at.

Among the resins, the genuine hard resins especially, but particularly copal resin and amber, are those which produce the most beautiful varnishes ; but, for certain purposes, the soft resins are indispensable, as with their help alone varnishes of sufficient elas-

ticity can be produced to permit the bending of the lacquered articles without cracking the coating.

Asphaltum,

also called black earth pitch, Jews' pitch, bitumen, etc., is found in many places upon the globe, stored in the earth or swimming upon the sea. The best known places where it is found are, for instance, the Dead Sea in Syria, and the Pitch Lake in the island of Trinidad. Asphaltum is a pitch-dark brittle mass, with a flat, conchoidal fracture; generally it diffuses a disagreeable odor, resembling that of burning coal, which is especially perceptible when it is heated. When heated, asphaltum melts easily and throws off black, heavy vapors. When set on fire it burns with a bright flame depositing large quantities of soot, but leaving little ash, and this is made use of as a means of testing its purity, as adulterated asphaltum, which has been mixed with bad pitch, leaves a large quantity of ashes behind. In modern times asphaltum has been much used for manufacturing excellent, elastic, black lacquers, especially suitable for lacquering iron wares.

Tar Asphaltum.

Asphaltum must not be confounded with a chemical product, which is frequently brought into commerce under the name of asphaltum; this is the so-called tar asphaltum which is gained in the distilling of the tar oils. This is used for nearly the same purposes as

the mineral asphaltum, which it resembles in many respects.

Amber (Succinum).

Amber is the resin of trees of former ages, which originally stood upon land covered at the present time by the waters of the Baltic Sea. During storms the amber, whose specific gravity differs very little from that of water, is thrown upon the beach, or it is obtained by dredging the sand, though in some places it is also mined.

Amber has a yellow color, many pieces are entirely transparent, others clouded, etc. By heating and rubbing it considerable electricity is generated; when thrown upon live coals it burns with a white flame and develops a strong odor. Large pieces of amber are very costly, and such pieces are exclusively used for turned articles. For manufacturing lacquers and varnishes only the small pieces and chips falling off in working larger pieces are used. The so-called *rasura succini* of druggists consists of such chips. Amber should only be procured from well-known dealers, as it is frequently adulterated, and the adulteration, which is done with powdered copal, etc., cannot be easily detected. Amber can only be dissolved in solvents by treating it in a certain manner, and has this property in common with other hard resins. We will later on refer to this behavior.

Benzoin Resin.

Benzoin resin is found in Asia, and comes into commerce from India and the East Indian islands, and is obtained from the Styraceæ. Several varieties of benzoin come into the market. The best quality is the so-called almond benzoin, which consists of white grains caked together with a brownish mass lodged between them, and which, when it is heated, diffuses an agreeable odor; the second quality shows the white masses less frequently, is of a darker color, and is frequently mixed with many chips of bark and wood. Good benzoin should completely dissolve in strong spirit of wine. It is more frequently used for the manufacture of sealing-wax than for varnishes.

Colophony,

or common resin, is obtained, as is well known, from our Coniferæ; the viscous turpentine is the balsam of this resin consisting of oil of turpentine and resin. Pure common resin (colophony) has a light amber color, is transparent as glass, and very brittle. Common resin less pure is called pitch-yellow, red, black-pitch. Lately, an excellent quality of very light colored common resin has been imported from America, and this is especially well adapted for the manufacture of many varnishes and lacquers.

Copal Resin.

Copal resin comes from the tropics and is found in commerce in very varying qualities. Usually a dis-

tinction is made between copal from the East and the West Indies, though a large number of varieties are named after the localities from which they have been brought into the market. Differing from all other resins in this respect, *all copal resins are very hard, melt only at a very high temperature and can only be dissolved with great difficulty in the solvents ordinarily used for resins.* In this it resembles amber, and, further, many varieties are dug out of the ground like the latter, while other varieties are gathered from the trees themselves. It is very likely that the copal which is dug out of the ground is also a product of extinct trees.

Copal is the *most important* of all resins used for the fabrication of fat lacquers, and for this reason we consider it necessary to describe more fully the principal varieties. Generally, copal is divided into two classes, namely, hard and soft copal. Rock-salt can be easily scratched with the hard varieties.

Hard Copal, East India Copal, Zanzibar Copal.—This copal is dug out of the ground, and comes from the east coast of Africa. It forms mostly flat, discoid pieces from the size of a pea up to that of a hand. These pieces are either entirely colorless, or yellow to a dark reddish-brown, and are transparent. The surface of this copal is peculiarly warty, and so hard that it can be ground.

Copal from Sierra Leone comes mostly in the form of globes or drops, forms at the utmost pieces as large as a nut, and is equally as hard as the East India

copal. *Gaboon copal* is roundish, of a yellow color, and many pieces are clouded blood-red. *Angola copal* resembles very much the Zanzibar copal, but consists mostly of globular somewhat flattened pieces, which are almost always of a dark golden-yellow color, but somewhat softer than the other varieties.

Soft Copal; West India Copal.—By this name certain varieties of copal are known which mostly come into the market from the west coast of Africa, and only in very small quantities from South America. While the plants which secrete the East India copal are entirely unknown to us, we do know that the South American copal is obtained from different plants belonging to the Hymenæa family. The West India copal generally forms globular or drop-like pieces from the size of a pea to that of a fist, is white, transparent, and sometimes, but rarely, clouded. It is so soft that it will lose substance when rubbed upon woollen stuff.

Kawrie Copal is obtained from *Dammara australis*, indigenous in New Zealand, and forms sometimes lumps weighing over 50 kilogrammes (110 lbs). Lighter and darker streaks run through these lumps, and they have an aromatic odor. While all other copals become gritty when chewed, this variety sticks to the teeth. On account of its low price, the Kawrie copal is much used at the present time for the fabrication of varnishes. The *Manilla copal* and *Borneo copal* resemble very much the New Zealand product.

Hard copal has no taste nor smell, the *soft* varieties

have an aromatic smell and taste. Copal is easiest dissolved in chloroform and absolute alcohol, that is, alcohol entirely free from water, but in the latter only when it has been first soaked in ether. It is very difficult to dissolve in benzol, oil of turpentine, petroleum naphtha,—all excellent solvents for other resins. Copal only dissolves easier when it has been first subjected to a partial dry distillation.

Dammar Resin

is obtained from *Dammara orientalis*, which is cultivated in the East Indies. The resin is gained by incisions which are made in the trunks of the plants, or the voluntarily exuding mass is gathered. Dammar resin forms drop-like masses as large as a small apple, or sometimes, also, larger pieces, resembling icicles. These pieces are either entirely colorless, or very light yellow, and smooth. The warmth of the hand is sufficient to make dammar sticky, and a powder is formed by rubbing it with the finger. At a temperature of 70° C. (158° F.) dammar becomes entirely soft, at 100° C. (212° F.) forms a viscous mass, and becomes fluid at 150° C. (302° F.). It can be entirely dissolved in hot spirit of wine. The variety which comes into the market as dammara australis is Kawrie-copal.

Elemi Resin

is obtained from trees belonging to the Burseraceæ family, and is produced in America, the East India, and Manilla. Elemi forms either a very thick, yellowish-

white balsam, possessing a strong, aromatic taste, and smell like the Manilla elemi, or solid, lamelliform masses like the Mexican elemi, which shows a conchoid fracture of a slight yellowish color, becomes white as milk when exposed to the air, and covered with a white, crystalline powder.

Elemi must be considered as an intermediary product; besides two different kinds of resin, one of which is soluble in cold, and the other in hot spirit of wine, there are found in elemi varying quantities of essential oil. Elemi resin is seldom worked by itself for varnishes, but it is frequently added to other varnishes, as it prevents them from becoming brittle and cracking in drying.

Gutta Percha

gained from an East Indian tree, the Inosandra gutta, is not a resin in the same sense as those which we have already described, but a substance related to caoutchouc, which flows from incisions made in the tree, and becomes hard when exposed to the air. The commercial gutta percha forms brownish, tough, sometimes fibrous masses, which become thoroughly plastic at 60° C. (140° F.), and melt at 120° C. (248° F.). Gutta percha is easily dissolved in bisulphide of carbon and chloroform, and also in petroleum naphtha. It remains as a water-proof coating after the solvent has evaporated.

Caoutchouc,

Gummi elasticum, is the thickened milky juice of different trees indigenous to the tropical regions, but it is also found in our European varieties of milk weeds (*Asclepiadeæ*), though not in sufficient quantities for industrial purposes. It forms a tough, very elastic mass, composed of carbon and hydrogen. It can only be partly dissolved in most of the known solvents, while what remains swells up, and can be dissolved with the least difficulty in those volatile products which are gained by the dry distillation of the caoutchouc itself. In modern times caoutchouc has become of the utmost importance for the fabrication of water-proof varnishes.

Besides the ordinary caoutchouc, there comes into the market also the vulcanized and hard caoutchouc. Vulcanized caoutchouc is of a grayish color, and is obtained by treating ordinary caoutchouc with sulphur. *This variety cannot be used for the fabrication of lacquers and varnishes.* The hard caoutchouc is also gained by chemically treating the ordinary variety; it forms hard masses of a black color, resembling somewhat buffalo-horn (the rubber combs are made from it), and is suitable for the manufacture of some important lacquers.

Mastic

comes principally from the island of Chios, where it is gained by making incisions in the trunks of the *Pis-*

tacia lentiscus. It forms roundish, yellow masses about as large as a pea, and has an aromatic taste and (when heated) an agreeable smell. Mastic dissolves partly in cold spirit of wine, but completely only in boiling alcohol. Lately a resin from the East Indies has been introduced into the market under the name of Bombay mastic, which resembles in some respects the genuine Chios mastic.

Sandarac.

This resin flows from the bark of a species of cypress, *Callitris quadrivalvis*, which is found in North America, and forms tear-like masses of a wine-yellow to brown color. It melts at 130° C. (266° F.), devoloping then a very aromatic odor; it is only partly soluble in spirit of wine. The so-called German sandarac differs very much in its properties from the genuine, and consists of the resin of the juniper bush (*Juniperus communis*).

Shellac

flows from the branches of certain East India trees, in consequence of injuries inflicted by a species of coccus (*Coccus laccæ*). It hardens at the same time with a very beautiful red coloring matter, which is called lac-dye. The resin separated from the coloring matter is shellac, which is found in commerce in different qualities, and is called according to its color, ruby shellac, blond shellac, etc. Generally shellac has a light-yellow, brown, or reddish-brown color, and is

easily dissoluble in strong alcohol. The solution forms a varnish very much used, the so-called cabinet-makers' varnish.

By treating the solution of shellac with animal charcoal, or with a solution of chloride of lime, the shellac can be *perfectly bleached to white masses shining like silk.* As the bleached shellac commands an extraordinarily high price, many manufacturers will prefer to bleach the shellac themselves.

Bleaching with Chloride of Lime.—First a solution of 1 kilogramme (2.2 lbs.) of chloride of lime in 1 kilogramme of water is prepared, and this is compounded with a solution of soda, until no more precipitate is formed. The clear fluid is poured off and is added to 10 liters (2.64 gals.) of spirit of wine solution of shellac and thoroughly shaken. The entire mass is then allowed to stand till it is observed by the color of the fluid that the bleaching is done. This generally takes place in half an hour to an hour, and quicker under the influence of the direct rays of the sun than a scattered light. The bleached fluid is then poured into a large stoneware pot or enamelled vessel, and hydrochloric acid is added as long as resin is separated. The resin separated by adding the acid is of a very light-yellowish color, and loses the remaining part of the coloring matter by washing it in boiling water. For the purposes of the varnish manufacturer it is of course entirely unnecessary to fashion the bleached shellac into the form resembling skeins of white silk, in which it is brought into the market.

Turpentine,

which is obtained from the cone-bearing trees (fir, pine, larch) and, as has been already mentioned, is an intermediary product between the oil of turpentine and resin. In commerce it is divided into many varieties according to color and viscosity. One variety is called *Venetian* turpentine. This is gained from the larch tree, is yellow like honey, and viscous, and has a not disagreeable smell.

On account of its half-fluid property turpentine is also used for diminishing the brittleness of certain lacquers and varnishes.

Wax

is the well-known product of the bee. In commerce a distinction is made between the natural or yellow wax and the bleached or white wax; the latter variety only is used for preparing some varnishes (except we would class certain so-called floor lacquers, for the fabrication of which yellow wax is also used amongst the varnishes). Wax only partly dissolves in boiling spirit of wine, but does so entirely in ether, oil of turpentine, benzine, and sulphide of carbon. The commercial wax is frequently badly adulterated with a vegetable substance, the so-called Japanese wax.

Cerasin.

By the name of cerasin or artificial wax a substance having the appearance of wax is brought into the

market which may be used for the fabrication of varnishes for floors; as far as its chemical properties are concerned it has nothing in common with wax.

Paraffin

is a substance contained in tar which, in a pure state, forms a white mass looking like alabaster, and at the present time is frequently used in the manufacture of candles. It is also used for the fabrication of a few lacquers, and serves at the same time to make them less brittle.

VI.

COLORING SUBSTANCES.

Coloring substances are of importance in the fabrication of lacquers and varnishes in so far as they are used to produce a certain tone of color in many varieties, and as a certain color is demanded for some varnishes, as is, for instance, the case with the so-called gilder's-varnish, which must always be of a bright yellow color. To be of any value for our purposes the coloring substances used must especially possess two qualities; they must be transparent, and lasting when exposed to the light. In the first respect the aniline colors, so much liked at the present time, give great satisfaction, but as far as the latter quality is concerned the older colors deserve the preference, though they are not so beautiful as the aniline colors.

Aniline Colors

are prepared on a large scale in special factories. They are produced from coal-tar, and can be bought in all shades and tones of color. Varnishes to which aniline colors have been added make a magnificent show of color, especially when they are laid on a metallic ground; in regard to this we would only call attention to the extraordinarily beautiful colors of a metallic lustre which are displayed by the tinfoil used for wrapping fine chocolate, etc., and with which the corks of bottles are covered. Unfortunately, as we have already mentioned, these beautiful colors possess but little durability.

Turmeric,

curcuma, or the *radix curcumæ* of druggists. Of this, two varieties are known in commerce: the first, *curcuma longa*, forms articulate pieces as long as the finger and of the thickness of a lead-pencil. Externally it is of a yellowish-gray color, while the interior is of dark orange color and resinous. The second variety, *curcuma rotunda*, forms tubers of the size of a nut, but its properties are the same as those of *curcuma longa*. The Chinese turmeric is considered the best, the next best is the Japanese, while the Barbadoes turmeric is the poorest quality. The coloring matter of the turmeric is easily soluble in spirit of wine, and has a bright yellow color, but possesses but little durability when exposed to the light.

Dragon's Blood,

sanguis draconis, is a resin of a deep dark red color, which is obtained from the different species of *Dracœna*, which are all indigenous in the tropical regions, as well as from other plants. Dragon's blood comes into the market either in the form of small balls or in sticks about 3 decimeters (11.8 inches) long—in both cases enveloped in leaves—or in irregular masses which look as if they had been melted. Several varieties of this article are found in commerce, but especially that from the East and West Indies and from Africa.

Dragon's blood has a dark blood-red color, but the red shines through only on the edges or in very thin pieces. The fracture has a strong lustre. It can be easily pulverized, and when heated diffuses an odor similar to that of storax. The dragon's blood found in commerce is frequently badly adulterated, and even products are sold as dragon's blood which consist of gum colored with sanders wood. When genuine dragon's blood is rubbed against a glass-plate it makes a mark very much resembling a streak of blood, which is not the case when the article has been adulterated.

Gamboge.

Gamboge is a so-called gum resin, and consists of gum, resin, and a bright yellow coloring matter. In commerce it appears in various forms, as pipe gamboge, cake gamboge, and lump gamboge. Gamboge consists of the milky juices boiled down of the different

trees belonging to the family of *Guttiferæ*. The pieces are generally yellow or brownish-yellow, the surface is covered with a greenish powder, and only somewhat transparent when very thin.

Gamboge dissolves only partly in alcohol, but completely in ether; with water it forms an emulsion, *i.e.*, the resin is kept suspended in the fluid by the dissolved substances. This substance is of the greatest importance in the fabrication of varnishes, as it is used for preparing the so-called gold-lacquer, a varnish used for coating wash-gold frames.

Indigo.

This magnificent blue coloring matter, one of the most constant we know of, is obtained from the indigo plant, *Anil indigofera*, indigenous in the Indies, but also cultivated in other tropical countries. It is gained from the plant by a peculiar, chemical process. Dealers divide it into a large number of varieties, but we cannot enter here into a more particular description of them. Indigo should always be bought in pieces, because the powdered article is frequently badly adulterated with other blue coloring matter. Special attention should always be paid to a certain characteristic of a good quality of this article, namely, when the dark blue pieces are viewed in a certain direction, they show a beautiful, metallic copper-lustre, which appears the stronger when the surface is smoothed by rubbing it with the nail of the finger. Indigo by itself cannot be brought into such a soluble form as to

allow of its being mixed with varnish or lacquer; even if very finely powdered indigo is rubbed together with a varnish or a lacquer, a blue, well-covering paint will be obtained, but not a transparent product. A transparent, blue lacquer or varnish colored with indigo can only be obtained by using the so-called indigo-carmine.

Indigo-carmine is prepared in the following manner: Indigo is powdered as finely as possible, is placed in a capacious glass vessel and dried for several hours at a temperature of 110° C. (230° F.). Enough fuming sulphuric acid is then poured over the powder to cover it. The mass swells up very much, and the action of the sulphuric acid is assisted by frequent stirring. After twenty-four hours the fluid is diluted with ten times its quantity of water, is allowed to settle, and is then poured off from the sediment. The solution is then compounded with carbonate of potash as long as effervescence takes place, and then the dark blue precipitate which is formed is spread upon bricks and allowed to dry. When it is desired to color varnish with indigo-carmine, the latter is rubbed with the varnish upon the grinding-stone, and gradually enough varnish is added to form a fluid mass, and this is stirred together with the rest of the varnish.

Lampblack.

As is well known, this product is a very finely divided carbon which is separated in the form of black

flakes mixed with other organic combinations by the combustion of resins and fat oils. Good lampblack, and in fact every variety of soot, should produce a fine mass which can be easily rubbed together with fat oil, and should be of a purely black color. Lampblack prepared at too low a temperature has mostly a brownish shade of color, while that which has been heated too much has a weak black color, and is granular, which renders it more difficult to mix with the varnish.

Seed-lac

is a product nearly related to shellac. As has been previously mentioned, a red coloring matter exudes with the shellac from certain trees in consequence of injuries inflicted by the *Coccus lacca*. Frequently the resin and lac envelop the animal with a coating, the so-called stick-lac, from which the resin is gained by heat, while the remaining mass composed of the bodies of the animals forms the seed-lac. The seed-lac should form compact masses of a dark red color. Besides this seed-lac, the actual coloring matter, the lac-dye is gained by boiling it in water, and by allowing the fluid to dry up. Good lac-dye has a fiery red color very much like cochineal.

Saffron

consists of the stigma of the saffron plant, *Crocus sativus*, a species of iris, and is especially cultivated in Austria and France. On account of its high price saffron is only too frequently adulterated with other

vegetable matter, or the coloring matter is partly extracted and the dried substance is again brought into the market. As at the present time many coloring substances are known which form a very good but decidedly cheaper substitute for saffron, but little of the latter is now used in the preparation of varnishes.

Sanders Wood,

Lignum santali rubrum, or red sanders wood, is sometimes confounded with sandal wood. It is the wood of the *Pterocarpus santalinus*, and furnishes a beautiful red coloring matter, whereas the sandal wood is either white or yellow. Sanders wood is brought into the market in large logs, the outsides of which have a brownish-red appearance, while inside they show a beautiful red color. Sanders wood which is brought into the market in the form of chips is frequently badly adulterated.

Besides the above-mentioned coloring substances, many vegetable substances may be used for coloring varnishes and lacquers. This is especially the case with spirit varnishes, as most of these coloring substances are soluble in spirit of wine, while many of them are insoluble in fat oils. We have described in the foregoing only the most important coloring substances, because the others are less frequently used, and besides, in case of necessity, the different colors may all be produced by a judicious mixing of the mentioned coloring substances.

VII.

CHEMICAL PRODUCTS.

CERTAIN metallic compounds possess the power of increasing the property of drying oils to become insoluble in a certain time when exposed to the air in thin layers, in such a degree that the drying takes place in a proportionally short time. The preparation of the so-called siccatives depends entirely on a suitable treatment of the drying oils with certain metallic compounds.

We know especially three metals whose compounds are excellently adapted for the fabrication of varnishes, namely, lead, manganese, and, to a limited extent, zinc.

COMPOUNDS OF LEAD.

Litharge.

A compound of lead most frequently used in the fabrication of varnishes is the monoxide of lead, also called litharge or massicot, and, according to its lighter or darker color, silver or white litharge, or gold or red litharge. Monoxide of lead, PbO, is formed by heating lead in contact with the air, by which process, as is well known, a film is formed upon the surface of the metal, which is renewed as soon as the first

is removed, and so on until all the lead has been oxidized. Litharge on a large scale is obtained as a by-product in gaining silver from argentiferous lead, and is freed from small particles of lead mechanically mixed with it by grinding and washing it.

Pure ligharge is a yellow powder, sometimes of a lighter or darker color. It fuses at a strong red heat, and when cold solidifies into scaly crystalline masses.

Red Lead.

Red oxide, or minium, is also an oxide of lead, which contains more oxygen than the common monoxide of lead. Its composition is Pb_3O_4.

Red lead is manufactured by carefully heating litharge in contact with the air until this is brought nearly to its point of fusion, but without allowing the heat to rise to the fusion point of the litharge. The monoxide of lead continues to absorb oxygen from the air, and is gradually changed into a powder of a peculiarly red color, which is used as a paint and also as a very durable cement for gas and water conduits.

Sugar of Lead,

or acetate of lead, is a crystallized salt, clear as water, which is obtained by dissolving litharge in vinegar and by evaporating the solution. The crystals of sugar of lead have an intensely sweet taste—hence the name—but a very disagreeable, metallic after-taste. They are poisonous like all other compounds of lead, and when exposed to the air become covered

with a white powder—they effloresce. When sugar of lead is dissolved in water, it may happen that a part of the salt is not dissolved, and the fluid will have a milky appearance. In such a case an insoluble acetate of lead has been formed, but it can be entirely dissolved in a short time by adding a small quantity of vinegar to the fluid and heating it.

Lead Vinegar,

which is also sometimes used in our branch of industry, is formed by dissolving litharge in a solution of sugar of lead. The best plan is to suspend the litharge inclosed in a linen bag in the solution, as by doing this the labor of shaking the bottle, which else would have to be done very frequently, is saved. The solution of sugar of lead takes up a large quantity of litharge, and is changed thereby into a soluble basic acetate of lead—lead vinegar. The solution must be kept in *hermetically closed* bottles, or else the fluid would become turbid from a basic carbonate of lead (white lead) precipitated by the carbonic acid contained in the air.

Disadvantages of Compounds of Lead.

To be sure, the compounds of lead produce siccatives, leaving nothing to be desired as far as drying is concerned, but they possess one disagreeable property, *namely*, *lead has an uncommonly strong tendency to combine with sulphur*, and the sulphide of lead formed in consequence of this combination is of a deep black

color. Small quantities of sulphuret of hydrogen, which is generated in cess-pools and manure-heaps, are always present in the air of our dwellings; even the human cuticle secretes small quantities of this compound. Therefore varnish prepared with a compound of lead, when exposed to the air, will soon absorb sulphuret of hydrogen, and acquire a darker color. This change can be easily observed by the difference of appearance presented by an object painted white and varnished a few months ago with such a varnish, from one freshly painted and varnished with the same kind of paint and varnish; while the latter will present a pure white color, the former will have acquired a yellow shade of color from the compound of lead contained in the varnish having been partly changed into sulphide of lead.

But a still greater disadvantage arises when a varnish prepared with a compound of lead is to be used with different artists' colors. *Some of the very important of these colors consist of compounds of sulphur*, as, for instance, cadmium yellow (jaune brillant) of sulphide of cadmium, cinnabar (vermilion) of sulphide of mercury. Now, if varnish is brought by such a color into intimate contact with a compound of sulphur, a reciprocal action takes place in a short time between the lead contained in the varnish and the sulphur contained in the color, and always in such a manner that black sulphide of lead is formed in all cases, whereby the color loses its beauty and lustre, and in a short time assumes a smoky appearance.

It has been tried for a long time, and many experi-

ments have been made to entirely banish the compounds of lead from the fabrication of varnishes, as well as of paints, and to find a suitable substitute for them.

Very favorable results, indeed, have been obtained as far as the fabrication of lacquers and varnishes is concerned, as we are now able to produce varnishes entirely free from lead, and of an excellent quality. The compounds of manganese especially have proven themselves an excellent substitute for the compounds of lead.

Compounds of Manganese.

Manganese is a metal bearing a close resemblance to iron in regard to its properties, and is found in a natural state, especially in the mineral called pyrolusite. A great number of compounds of manganese have been recommended for use in the fabrication of varnishes; besides the natural binoxide of manganese (pyrolusite), the hydrate of protoxide, the protoxide, hydrate of sesquioxide, and sesquioxide of manganese, the permanganate of potassium, and especially *the borate of manganese*, are used.

The pyrolusite furnishes the raw material for preparing the compounds of manganese, or, should it be preferred not to use this body, the sulphate of protoxide of manganese can be bought entirely pure in the stores. The sulphate of protoxide of manganese forms beautiful rose-colored crystals, soluble in water.

If pyrolusite is to be dissolved, it is heated in a

vessel of stoneware or glass, together with hydrochloric acid, which dissolves it, disengaging at the same time considerable quantities of chlorine. Where chlorine can be profitably used, as, for instance, for bleaching shellac, it may be recommended to work in this manner, but it is more convenient to use the sulphate of the protoxide, as the chlorine is very disagreeable, on account of its smell.

Hydrate of Protoxide and Protoxide of Manganese.

These compounds are formed by adding caustic potash to a solution of sulphate of manganese in water. The whitish-gray precipitate which is formed is collected upon a filter, washed eight or ten times with water, and dried. But *the air must be excluded* while this is being done, as the protoxide eagerly absorbs oxygen from the air, and is thereby changed into sesquioxide, which may be recognized by the precipitate assuming a brown color. For this reason the protoxide of manganese is less frequently used as such, but is generally set free from a compound only at the moment when it shall act upon the oil. How this is done we will explain later on.

Hydrate of Sesquioxide, and Sesquioxide of Manganese

are formed by preparing the hydrate of protoxide in the foregoing manner, but the precipitate is allowed to dry in the air, whereby it is changed into the hydrate of sesquioxide by absorbing oxygen. The

hydrate of sesquioxide is freed from water by gently heating it, and thus the sesquioxide of manganese is obtained. The pure sesquioxide is a soft, dark-brown powder.

Binoxide of Manganese

is used in its simplest form, as finely powered pyrolusite. But pyrolusite should never be bought in the form of powder, but only in pieces, as the commercial powder is badly adulterated with foreign substances.

Permanganate of Potassium

is a salt which is obtained by fusing pyrolusite with saltpetre. It is found in commerce in beautiful dark-red crystals, forming, when dissolved, a deep purple liquid. Permanganate of potassium very easily evolves oxygen, and therefore has a very strong oxidizing effect.

Borate of Manganese

is the most important of all the compounds of manganese used for the fabrication of varnishes. Though it can now be bought in the stores, yet, on account of the high price asked for it, it is advisable for every manufacturer to prepare it himself. The process differs somewhat according to whether pyrolusite or the sulphate of protoxide of manganese is used.

Borate of manganese is obtained from pyrolusite by dissolving the latter by boiling it with hydrochloric acid. The solution is then evaporated in a porcelain

dish until it seems to contain but little acidity, and then a small portion of a solution of soda in water is from time to time added to it. After the first portions of the soda solution have been added, the fluid becomes effervescent, and the precipitate formed is again immediately dissolved. This is continued as long as any free acid is present. Should the precipitate not become dissolved even if thoroughly stirred up, some of the soda solution is carefully added to it; this is entirely discontinued when the precipitate, formed in a sample of the fluid, is entirely white, which proves that the fluid contains no more sesquioxide of iron. *If sesquioxide of iron were present the borate of manganese would be colored brown.* After the fluid has been freed from the sesquioxide of iron it is filtered, and a hot solution of borax is then added as long as a white precipitate is formed. This precipitate, consisting of pure borate of manganese, is filtered off, and washed with hot water until a drop of the wash-water leaves no perceptible residuum when evaporated upon a watch-crystal. The funnel containing the salt is then covered with filtering paper, and the borate of manganese is dried.

Borate of manganese is prepared from the sulphate of protoxide of manganese in the following manner. One part of the salt is dissolved in ten parts of distilled water, and the formation of borate of manganese is immediately effected by adding the hot solution of borax, but as a precaution the solution of the sulphate of protoxide should first be tested with some soda to

determine whether any iron is present. If no iron is present, the precipitate will be of a pure white color, but of a greenish or yellowish color if iron should be present.

It is not only the beautiful appearance of the preparation which causes us to recommend particular care that it be entirely free from iron; but we have learned from experience that, if the borate of manganese contains any iron, the varnish prepared with such borate will dry very slowly, while varnish prepared with a pure article dries remarkably quick.

Oxide of Zinc

is also used at the present time for the fabrication of fat varnishes. It is obtained by the combustion of zinc in contact with the air, and forms a brilliant white powder. The zinc-white, prepared in zinc works, is a very pure oxide of zinc, and may be used for the fabrication of varnishes without further preparation.

In the foregoing we have described the most important chemical preparations used in the manufacture of varnishes. What is required to be said of other chemical preparations, less frequently used, and which can always be procured in commerce in a sufficiently pure state, as, for instance, Prussian blue (the pure varieties of it are also called Paris blue), which is used for the so-called blue lacquer, will be mentioned when we treat of the respective varieties of varnish.

FABRICATION OF VARNISHES AND LACQUERS IN PARTICULAR.

VIII.

DISSOLVING, ROASTING, AND DISTILLING (MELTING) OF RESINS.

The larger number of the resins can be dissolved without much difficulty in the respective solvents, provided that they are finely powdered and are prevented from caking together by a simple knack of hand. But the two hardest resins we know of, namely, copal and amber, require *a special preparation* to make them soluble. None of the known solvents completely dissolve these resins under ordinary circumstances. Copal, for instance, remains almost entirely unchanged in cold spirit of wine, while it only swells up to a tough elastic mass in boiling spirit of wine, but does not dissolve.

Dissolving of Resins.

The larger part of copal becomes soluble by a continued roasting, but a certain quantity of the resin still remains which resists the most effective solvents. Copal, as well as amber, can only be brought into an

entirely soluble form by *a partial dry distillation*, frequently erroneously called "melting." As far as the other resins are concerned, it is generally sufficient to powder them finely and to use heat for dissolving them, but the entire process only passes off smoothly and without trouble when the resin which is used is entirely uniform. It frequently happens that certain pieces of one and the same kind of resin require twice as long for dissolving as others, and by this time and eventually fuel are lost.

The property in resins of being dissolved easier or with greater difficulty coincides with their other physical qualities. Pieces having the same degree of hardness, the same color, and the same lustre, will generally dissolve in the same space of time. We would, therefore, urgently recommend *to sort the resins before they are used*, and especially according to color and the degree of transparency. The labor occasioned by this will be richly compensated by the time which is saved in dissolving them.

To effect the dissolving of the resins in as short a time as possible they should be finely powdered; but if the powder is mixed with the solvent without further preparation, the small particles of resin will cake together, and the surface of the mass formed thereby will become covered with a thick slimy solution which will seriously impede the further dissolving and retard it very much indeed.

To preserve the resin in the form of powder in the solvent it becomes necessary to mix it with some in-

different substance, and to add it to the solvent in this shape. Fine drift-sand is very suitable for the purpose, but only if it consists of *pure quartz*. If such sand cannot be procured, it is best to use *powdered glass*, which can be freed from its mealy parts by a fine wire-sieve. The best plan is to mix the powdered resin and powdered glass in equal proportions.

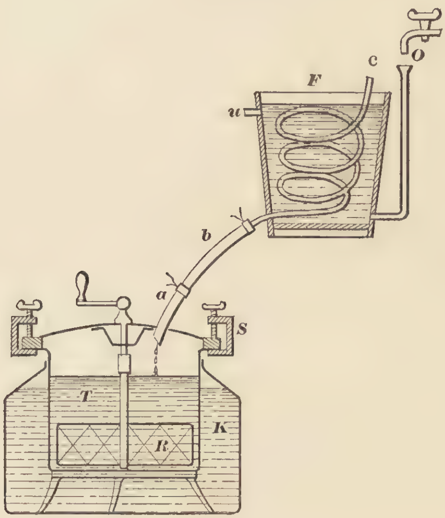
The solvent is heated for the purpose of hastening the dissolving of the resins. The solvents are all volatile, some of them, as, for instance, ether, bisulphide of carbon, etc., extraordinarily so. If, then, open or only loosely covered vessels are used for heating the solvents for a considerable time, a large proportion of them will be lost. And to this may yet be added that the vapors of all these fluids are very inflammable, which must be especially taken into consideration on account of danger from fire.

In the accompanying illustration, Fig. 2, we give a representation of a cheap apparatus offering all the advantages desirable for dissolving resins in volatile solvents, as it allows of dissolving them in every kind of solvent, be it never so volatile, without losing any of the latter, and at the same time preventing all danger from fire.

The apparatus consists of a pot, *T*, enamelled inside, and with a flat rim. This stands upon a trevet in the boiler, *K*, which is considerably narrowed towards the top, and filled with water. Binding-screws, *S*, press the lid tightly upon a rubber or leather ring, thus making it air-tight. A stirring apparatus, *R*, permits

the mixing of the solid bodies in the vessel, *T*, with the fluid. A lead-pipe, *a*, the end of which is cut off obliquely, is fastened in the lid, and is connected by a rubber hose with the serpentine cooling pipe lying in the cooling barrel, *F*.

Fig. 2.



When this apparatus is used, the water in *K* is brought to the boiling point, and as soon as the vapors of the solvent commence to show themselves on the upper end of the pipe, *c*, water is allowed to flow continually through the upright tube, *O*, into the lower part of *F*. The vapors ascending through *b* condense

in the cold pipe, c, and flow constantly back in the form of drops through a to T. The water in F on becoming warm ascends, runs off at u, and is replaced by cold water flowing in at O.

The water in K is brought *to the boiling point only when oil of turpentine, petroleum, tar oil, or spirit of wine* is used, but it should *never be heated above* 50° C. (122° F.) *when chloroform, wood spirit, or sulphide of carbon* is used, as the boiling points of these fluids are considerably lower; and it should *not be above* 40° C. (104° F.) *when ether and petroleum naphtha* are employed, and then it is advisable to throw pieces of ice into the water used for cooling, as common well water is not cold enough to condense the vapors of ether.

From the above description it will be seen that it will be absolutely necessary to procure some apparatus of this kind, if it is desired to prepare volatile varnishes. The size of the apparatus will, of course, depend on the capacity of the factory.

If it is desired to make the *solution of a resin*, which has been dissolved in a volatile solvent, *more viscid*, it is done in all cases by evaporating a part of the solvent. If this evaporation is accomplished in a small distilling apparatus connected with the upper part of the cooling pipe, c, the vapors condense in this and can be collected in such a manner that this part of the fluid can also be recovered.

Distilling (Roasting) of Resins.

As has been already stated, amber and copal require a special treatment to make them soluble with solvents. These resins are tolerably soluble in linseed oil by melting them, during which process a part of them always becomes decomposed. But to make them entirely soluble also in volatile solvents it becomes necessary to subject these resins to a dry distillation. Moreover, copal acquires the property of becoming easier soluble by being subjected for a considerable time to a strong heat.

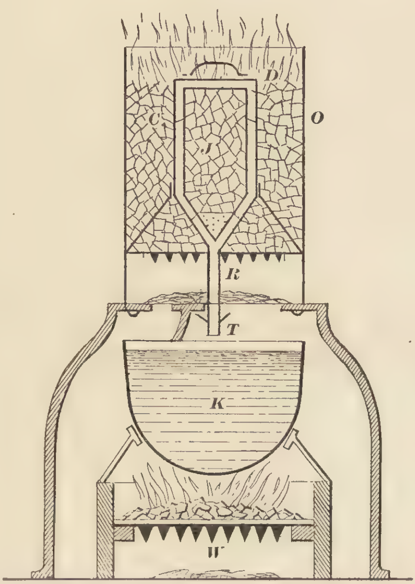
The process of roasting the copal is as follows: Finely powdered it is exposed for several days, the longer the better (generally forty to seventy-two hours will be sufficient), to a temperature varying between 180° and 220° C. (356° and 428° F.),—by the way, about the temperature of a strongly heated oven. During this roasting we must, as much as possible, avoid *touching the resins with metal, as they thereby become darker.* It is best to use large flat dishes of stoneware or porcelain, such as are frequently used in chemical factories, or shallow, well enamelled pots of cast-iron may be used. As neither copal nor amber undergoes any change at the mentioned temperature, but renders up only a small percentage of water, it seems almost as if the small percentage of water contained in the resin impeded its solubility.

Although copal becomes more soluble by roasting, yet it is an unsatisfactory process for the manufact-

urer, who must exhaust his raw materials as much as possible, and this would seem to be especially desirable in regard to the expensive resins. No absolutely complete solution of the resin is obtained by the roasting process. Better results are obtained by

Melting the resins, a process which, on account of its practicability and simplicity, may be especially recommended to small manufacturers, and which

Fig. 3.



produces fat lac-varnishes answering all ordinary demands. The peculiarity of this plan is, that the

preparing of the copal and the boiling of the lacquer can be accomplished by one process. The apparatus represented by Fig. 3 may be advantageously used for this purpose.

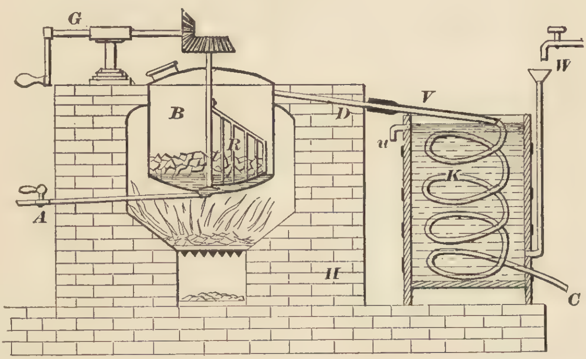
C represents a riveted cylinder of solid sheet-iron, with a tapering piece jointed to the bottom. This is placed upon several supports in a small furnace, *O*, which is heated with charcoal. The lid, *D*, fits tightly upon the cylinder, and must be plastered over with clay during the process of melting. A copper pipe, *R*, is screwed to the tapering piece of the cylinder. This pipe passes through the grate of the furnace and the ash-pit, and is provided with a small funnel-shaped contrivance, *T*, for catching the ashes which might possibly fall down.

In the cylinder *C* stands another cylinder *J* constructed of sheet-copper. This has also a tapering piece jointed to the bottom which is perforated with a large number of small holes like the rose of a watering-pot. Small strips of sheet-copper are riveted to the cylinder *J*, and hold it in such a manner as to leave a free space of one to one and a half centimeters (0.39 to 0.58 inch) between the two cylinders. A boiler *K* is placed under the pipe *R*. The linseed oil is placed in this boiler and a coal-fire in a small air-furnace keeps the oil in a gentle ebullition. The cylinder *J* is filled with pieces of copal, the lid *D* is placed tightly upon it, and the resin is melted by the coal-fire. As soon as the drops of resin commence to appear on the open end of *R*, the linseed oil is

brought to a brisk boil and constantly stirred. The melted resin dropping into the boiling linseed oil dissolves quite readily, and in this manner very serviceable copal lacquers are produced, but they have always quite a dark color. The precaution should be taken *not* to cleanse the copper cylinder after it has been in use, as the thin layer of resin adhering to the metal helps to protect it.

From 80 to 100 liters (21 to 26 gals.) of copal lacquer can be produced at one time by this simple process. But large quantities and the best quality of lacquer can only be produced by subjecting the resin to dry distillation. The distilling apparatus represented by Fig. 4 serves for this purpose.

Fig. 4.



A discharge pipe *A*, which must be coated with fire clay, is fastened in the bottom of a cylindric copper alembic *B*, which is bricked in in the hearth *H*, and

heated by an open fire. In the dome of the alembic is an opening which is closed by a screw-lid, through which the resin is introduced into the apparatus. The contents of the alembic are kept in motion by a stirring apparatus which is revolved by the driving gear *G*. The pipe *D* serves for carrying off the escaping vapors, and this is connected by the adopter *V*, with a tin serpentine pipe *K*, which lies in the cooling vessel *K*; the water in the latter is kept at a low temperature by cold water flowing in at *W*, which runs off as warm water at *u*. Below the opening *C*, a vessel is placed for receiving the off-flowing distillate.

According to the statements of some chemists, it is necessary *to silver* the inner side of the distilling vessel *B*, to protect it from the vapors of the melting resin, and to be able to use the latter for a light-colored varnish. But we have found that the same object may be obtained *by coating the inner side of a new vessel with good amber varnish.*

Thorough investigations by Violett have shown, that, to make copal entirely soluble, it is necessary to distil it until it has produced one-quarter of its weight in fluid products of distillation. But as evidently the price of copal increases the more there is lost of it, manufacturers generally do not go quite so far, but only reduce the weight of the copal from 10 to 20 per cent. by distillation.

Solvent for Copal.

Lately, many experiments have been made to dissolve copal without subjecting it to distillation, and many proposals have been made for reaching the desired object. One of these which answers the purpose quite well is as follows :—

	Parts.
Bisulphide of carbon	1
Oil of turpentine	1
Benzole	1

are mixed together.

The powdered copal is allowed to stand for several days in this fluid contained in a closed vessel ; the amount of copal taken at one time is usually one-half of the weight of the fluids. The solution, which is seldom a complete one, is poured off and compounded with a fat oil.

But most manufacturers prefer distillation, and this process still seems to us the most suitable.

To be able to determine how far distillation has advanced, a marked glass vessel is used in which the product of distillation running off at *C* is caught. The oils which are obtained from distilled copal and amber have always a certain density, namely, the mean of oil of copal is 0.800, and that of amber 0.900, *i. e.*, when a liter (2.1 pints) of water weighs 1000 grammes (35 ozs. avoird.), a liter of the first weighs 800 (28 ozs.), and a liter of the latter 900 grammes (31.5 ozs.).

If 100 kilogrammes (220 lbs.) of copal are worked at one time, the corresponding quantities of the distillate are as follows:—

For 10 per cent. distillate equal to the quantity of 8.0 kilogrammes (17.6) lbs. of water.

"	11	"	ditto 8.8 kilos.	(19.4)	"	"
"	12	"	ditto 9.6 kilos.	(21.0)	"	"
"	13	"	ditto 10.4 kilos.	(22.9)	"	"
"	14	"	ditto 11.2 kilos.	(24.6)	"	"
"	15	"	ditto 12.0 kilos.	(26.4)	"	"

It may be seen from the above, that the weight of the distillate increases 0.8 kilogramme (1.76 lbs.) for every per cent. For the distillate of amber 0.9 kilogramme (1.98 lbs.) corresponds to the 10 per cent., and the increase of weight is 0.9 kilogramme for every 10 per cent.

The marks on the glass vessel are scratched in with a diamond, and are obtained in the following manner: First, exactly 8 (17.6 lbs.) (for oil of amber, 9 (19.8 lbs.)) kilogrammes of water are weighed in the vessel, the level of the water is marked and the figure 10 put alongside the mark, then 0.8 respectively 0.9 kilogramme of water is added, the figure 11 is put alongside the mark, and the vessel is gradually graded according to the per cents. of the distillate.

The most suitable temperature for the dry distillation of copal is from 340° to 360° C. (644° to 680° F.), that of amber 380° to 400° C. (716° to 752° F.); if less heat is used, distillation progresses too sluggishly,

and should the heat be stronger, the resin acquires too dark a color. It requires a great deal of experience in firing to keep the temperature of the distilling vessel at this point without too great variations. We avoid this by placing the alembic in a lead-bath or sand-bath. Lead melts at 334° C. (633.2° F.); when it is once melted, the fire is so regulated, that the running off of the distillate takes place in drops following each other uniformly.

The oils which are obtained in distilling copal and amber are miscible with all solvents used in the fabrication of varnishes, and can be used to great advantage for dissolving soft copal without roasting or distilling it. But it can only be used for the *soft* varieties of copal, as the *harder* kinds do not furnish a clear solution even with these oils if they are not distilled.

IX.

PREPARATION OF VOLATILE VARNISHES AND LACQUERS.

By volatile varnishes and lacquers, we understand all those from which the solvent can be evaporated by heat without suffering decomposition; they, therefore, include all those varnishes which are not prepared with fat oils.

The varnishes most in use are the spirit and oil of

turpentine varnishes, or, to be more correct, they were until lately. The conditions have been changed since the great progress in the tar and petroleum industries have placed at our disposal, at very low prices, such excellent solvents as, for instance, benzole and petroleum naphtha. At the present time, the resins are very frequently dissolved in one of these solvents, and in such a manner that a fluid of the consistency of syrup is obtained which is reduced with spirit of wine or oil of turpentine as required. On account of the high price of spirit of wine 90 per cent. strong, it would seem also advisable to use the cheaper wood spirit instead.

Independent of the difference in quality of varnishes caused by the various resins, we find that the kind of solvent used also exerts a considerable influence upon the quality of the varnish.

Pure Spirit of Wine Varnishes

can easily be obtained of a color as light as water, if they are prepared in the right manner; they dry very quickly, especially in summer, and produce a smooth, glossy coating which seems to be faultless. But even if the varnished object is protected from all shocks, it will be found in a short time, especially after a great change in the temperature, that the varnish has *innumerable fine cracks*, in consequence of which it *loses its lustre* and even *peels off* if the layer of varnish has been somewhat thick.

The cause of this phenomenon is found in the fact,

that the layer of varnish or lacquer consists of nothing else but the unchanged resin which lies upon the article in a thin layer. As resins are mostly very brittle bodies, a very inconsiderable lowering of the temperature suffices to occasion a separation of the contracting particles, whereby the above-mentioned fine cracks are formed.

What has been said here in regard to spirit varnishes, holds of course good for all varnishes whose solvents take no part in the formation of the actual layer of varnish ; the more volatile the solvent is, the quicker the hard coating will be formed, and the easier will it crack, as can be observed, for instance, in those varnishes in the preparing of which ether alone has been used as a solvent.

The above-mentioned faultiness of spirit varnishes can be checked by dissolving at the same time, with the hard resins, also soft resins which are nearly allied to the balsams or turpentines, or by not using spirit varnish by itself, but mixed with an oil of turpentine varnish.

Oil of Turpentine Varnishes

are prepared by dissolving the resins in oil of turpentine. They are little liked, on account of their strong smell, which does not entirely disappear, even after the lapse of considerable time, though it may be removed by heating the varnished object. But there is still another reason against the use of pure oil of turpentine varnish. · Like all essential oils, oil of tur-

pentine strongly affects the nervous system; workmen who have worked for a long time with oil of turpentine varnishes, suffer from the effects of the vapors of the oil of turpentine.

As resins can be generally dissolved easier in oil of turpentine than in fat linseed oil, oil of turpentine varnishes are frequently added to the fat varnishes for the purpose of, in this manner, evading the greater difficulty of dissolving resins in fat oils. When used by themselves, oil of turpentine varnishes produce as beautiful a coating as spirit varnishes, and, moreover, possess the advantage of being less brittle. In a certain respect the oil of turpentine takes part in the formation of the layer of lacquer, as a part of it, even if it is only a small quantity, is changed into resin, becomes turpentine, and keeps the coating soft for a longer time. To be sure it requires a longer time to dry than spirit varnish, but in consequence of this, the particles of the coating find time to deposit themselves freely, and therefore, the coating cracks or breaks less frequently.

Tar-oil varnishes, as well as benzole and petroleum naphtha varnishes, possess nearly the same properties as spirit varnishes; the utmost precaution is absolutely necessary in regard to fire in preparing these varnishes. These fluids evaporate very quickly at an extraordinarily low boiling point, the vapor fills the air, and an explosion may take place if this comes in contact with fire. These volatile fluids can be most suitably used by bringing just sufficient resin in contact with

them to form a viscid fluid, and to reduce this with spirit of wine, oil of turpentine, etc., a knack which shortens the labor considerably, as the resins are dissolved considerably quicker in benzole and petroleum naphtha than in alcohol. As has been already mentioned, all alcohol used for dissolving resins must be *absolutely very strong*, and show at least 90 per cent.; but a somewhat weaker spirit of wine, about 85 per cent., or under certain conditions even only 80 per cent. strong, may be used for reducing a solution already made.

But it may be recommended in all cases to first determine by a preliminary test with a small quantity of varnish how far the use of weaker spirit of wine is advisable; because if it is too much diluted it has not the power of keeping all the resin in solution, and a part of the latter will separate in the form of flakes. When in testing the varnish it is observed that it becomes less transparent, especially when exposed to a lower temperature, or even commences to opalize, it is a certain proof that the spirit of wine has been diluted too much. Such spirit of wine varnishes as are required to dry very quickly must of course be prepared with spirit of wine containing as little water as possible, in fact the strongest alcohol obtainable in commerce should be employed for such varnishes.

It is desirable for certain mechanics, who wish themselves to prepare the spirit varnishes used in their occupations, that the labor should be simplified as much as possible.

Preparation of Volatile Varnishes on a Small Scale.

This is done in the most suitable manner by taking a wide-mouthed bottle, and fitting upon this as accurately as possible a cork, the lower end of which is provided with a small hook. The resins to be dissolved are tied up in small bags of fine and close linen, and are suspended from the hook in the bottle filled with spirit of wine in such a manner that they are just immersed in it. The dissolution of the resin is thus accomplished without the necessity of shaking the bottle, as the solution of resin which is formed, being denser than the spirit of wine, sinks to the bottom of the bottle, and the resin comes constantly in contact with new spirit of wine. As most resins first swell up very much before they dissolve when they come in contact with spirit of wine, the small bags must not be entirely filled, and the resins should be used in pieces about as large as a pea.

In manufacturing varnishes on a large scale it becomes frequently necessary to clarify them, as they often contain small particles which make them turbid; this can only be done by allowing the varnishes to stand for weeks in large bottles in places where they are safe from all *concussion;* the solid bodies will then gradually settle on the bottom, and the clear varnish can be poured off by careful handling.

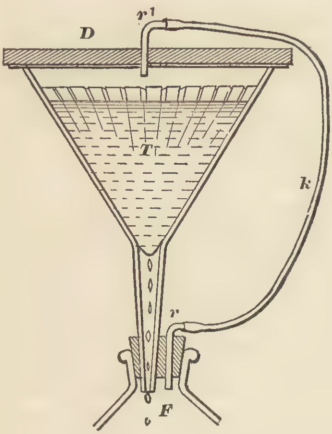
Leaving entirely out of view that this process requires a great number of expensive and easily broken

bottles, as well as considerable space for storing them, a certain percentage of the varnish is lost by unavoidable evaporation of alcohol, by spilling, etc.

Filtration of Varnishes.

The lightest colored and actually brightest varnishes are obtained by filtration. But as this process requires considerable time, and quite a quantity of spirit of wine, benzol, etc. would be lost by evaporation, it is necessary to use a suitable apparatus, so that these

Fig. 5.



evils may be remedied. An apparatus of this kind, of simple construction and performing excellent service, is represented by the accompanying illustration. It consists of a large bottle, *F*, either of glass or tin.

This is hermetically closed by a cork with two holes. The neck of the glass funnel, *T*, the upper rim of which is ground smooth, is placed in one of the holes, and a glass tube, *r*, bent at a right angle, is fitted into the second hole. A thick wooden lid with a ring of rubber on the lower side is placed upon the funnel, thus closing it air-tight. In the centre of the lid is fitted a glass tube, r^1, also bent at a right angle, which is connected with the tube *r* by a rubber hose, *k*.

Either filtering paper, as shown in the illustration, or fine cotton, is used as filtering substance, of which a cork is formed in the lower part of the cone of the funnel, and lightly pressed into the tube of the funnel. After the funnel has been filled with the fluid to be filtered, the lid is placed upon it, and must be removed only for the purpose of pouring more fluid into the funnel. The air in the bottle, *F*, is displaced by the fluid dropping into it, and escapes through *r*, *k*, and r^1 into the funnel, *T*, where it absorbs the vapor of the fluid, *but absorbs nothing more after it is once saturated.* While evaporation goes on constantly when an open funnel is used, it is entirely checked by using this apparatus. When it is observed that the pores of the filter become very much choked up, which may be recognized by a very slow dropping of the fluid, the contents of the filter are allowed to run off, and the filtering material is changed.

Decoloration of Varnishes.

It is necessary that many varnishes should be entirely without color; but even in those cases where only resins of the lightest color are used, the varnishes possess a more or less strong yellowish color. To remove this color varnishes must be subjected to a special treatment; they must be decolorized.

Animal charcoal is generally used in chemical industry as the most effective decolorizing agent. It seems to be most advisable for our purposes to use the animal charcoal in such small pieces, that it has the appearance of coarse sand; powdered animal charcoal to be sure is very effective, but the pores soon choke up, and filtering becomes a very tedious operation. The commercial animal charcoal must be freed from the salts contained in it to make it suitable for our purposes. This is done by treating it with hydrochloric acid.

10 kilogrammes (22 lbs.) of raw animal charcoal are placed in a stone-ware pot, having a capacity of about 20 liters (5.28 gals.), to this are added 5 to 8 kilogrammes (11 to 17.6 lbs.) of raw hydrochloric acid, and the entire mass is allowed to stand for one day in the *covered* pot, during which time it must be repeatedly stirred. The contents of the pot are then poured into a tub containing about 100 liters (26.4 gals.) of water; after the charcoal has settled, the fluid is poured off, and clean water is poured over it, and this is repeated until the water is entirely free

from acidity. (Blue litmus paper when dipped in the fluid must *not* be colored red.) The washed animal charcoal is dried by heat.

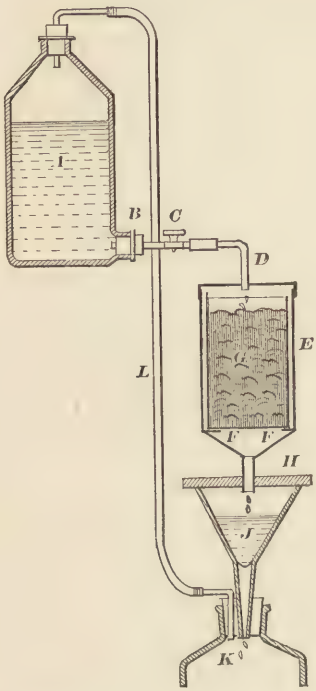
For preparing small quantities of varnish the decolorizing can be done at the same time as the filtering, by placing the animal charcoal in the funnel *T* (Fig. 5), and by pouring the varnish to be filtered upon this. But this has its disadvantages in respect to changing the filtering substance or the animal charcoal, if either one of these substances should lose its effect. We prefer, therefore, to carry on the processes of decolorizing and filtering in separate vessels. Fig. 6 represents an apparatus which allows both labors to be carried on at the same time.

The varnish to be decolorized and filtered is contained in a bottle *A*, having a second neck *B* near the bottom into which is fitted a pipe which can be closed by a cock *C*. This is connected with the pipe *D* by a piece of gum hose. The pipe *D*, as may be seen in the illustration, is fitted into the lid of the vessel *E*. *E* is a cylindric vessel of sheet-iron with a ring *F* on the bottom, which serves as a support for the cylinder *G*. This cylinder is of woven wire, and is filled with coarsely grained animal charcoal. The tapering piece jointed to the vessel *E* enters into a pipe which passes through the lid *H* into the funnel *J*. The lid is provided with a rubber ring. The funnel is fitted into the bottle *K*. A rubber pipe *L* connects the two vessels *A* and *K*.

By opening the cock *C*, the varnish is allowed to

flow into E, where it is decolorized by the animal charcoal. From there it passes immediately into the

Fig. 6.



filter, and the finished article is collected in K. The arrangement of the entire apparatus is such, that, should it become necessary, the filtering material or the animal charcoal can be changed in a short time,

and at the same time any loss by evaporation is prevented.

Coloring of Varnishes.

The best plan is to color the varnish after the entire work has been finished. First an entirely clear solution of the coloring matter should be prepared in alcohol, and this should be as concentrated as possible. Enough of this saturated solution is added to the fat varnishes to produce the desired shade of color. But as a considerable quantity of the solution of many coloring substances has to be taken for this purpose, it might be the case that in consequence of this the varnish would turn out too thin; this must be, therefore, taken into consideration, and the varnish must be made somewhat more viscid. When aniline colors are used no attention need to be paid to a possible thinning of the varnish in consequence of the addition of the solution of coloring matter, as these colors dissolve easily and are very productive.

X.

DIRECTIONS FOR PREPARING VOLATILE VARNISHES AND LACQUERS.

There are a great many directions for preparing varnishes and lacquers, and it is absolutely impossible to say which of two directions deserves the preference.

Frequently the so-called "new receipt" is, in many cases, nothing else but a direction for preparing certain varnishes and lacquers which have been already and well known for a long time.

To prepare a varnish which shall answer its purpose it is impossible to work at hap-hazard; it is absolutely necessary to know *for what purpose* the varnish is to be used. It is evident that a varnish which is to be used for coating objects of metal must possess different properties from such as is to be employed for leather; the first should be as glossy and hard as possible, while the latter should be pliant (elastic) and soft.

The different properties, on the one hand, that of great hardness, which is always combined with a certain degree of brittleness, and, on the other, elasticity and pliancy, can only be obtained by using different kinds of resin. The *hard resins*, like amber, copal, and shellac, to be sure, will produce very glossy but also *quite brittle* varnishes, whereas sandarac, mastic, elemi, venetian turpentine possess the property of making varnishes *more pliant* and *tenacious*.

From what has been said above it will be easy to change in a corresponding manner every direction given for preparing varnishes; should the varnish be too *soft*, the quantity of amber, copal, or shellac is increased; should it be too *hard and brittle*, it is remedied by an addition of *soft* resins, like mastic, elemi, or venetian turpentine, and anime.

The quantity of solvent to be used for a certain quantity of varnish varies also; evidently, viscid var-

nishes will be of greater value than thinly fluid varnishes, as the former can be reduced at pleasure. Generally two and a half parts of solvent are counted for one part of resin. For certain labors, as, for instance, for decolorizing and filtering, it has been directed to reduce the varnish. To give it again the necessary degree of consistency it is allowed to flow into a distilling apparatus, and enough of the solvent is distilled off to restore the right proportion between the resin and solvent.

When the business is carried on on a larger scale, it is very advisable to keep a stock of dissolved resins on hand, to prepare them at one time, when there is spare time for doing it, and to prepare the varnishes by simply mixing the solutions. To do this easily solutions containing the resins and solvents in a simple proportion should be prepared, and this proportion should be marked on the bottle, as, for instance—

	Parts.
Ruby shellac	1
90 per cent. spirit of wine . . .	5

By preparing such solutions on a large scale even the labor of filtering can be saved, as the solid particles still remaining in the fluid will sink to the bottom of the bottle if the solution is allowed to stand quietly for a few weeks, and the fluid will become entirely clear. Should the varnish prepared from the mixture be too thinly fluid, it is evaporated to the required consistency in a distilling apparatus.

Many manufacturers calculate the spirit of wine by liters, and usually consider 1 kilogramme (2.2 lbs.) of spirit of wine equal to 1 liter (2.1 pints), but by doing this the varnishes become always too viscid, as 1 kilogramme of spirit of wine amounts always to more than 1 liter, because spirit of wine is a less dense fluid than water. In the following we give a table which gives the weight of a liter of spirit of wine for those percentages of pure alcohol which are used in the fabrication of varnishes:—

1 liter (2.1 pints) of spirit of wine weighs in grammes (1 gramme= 15.43 grains)	And contains per cents. of alcohol
863.9	80
861.1	81
858.3	82
855.5	83
852.6	84
849.6	85
846.6	86
843.6	87
840.5	88
837.3	89
833.9	90
830.6	91
827.2	92
823.7	93
820.1	94
816.4	95
812.5	96
808.4	97
804.1	98
799.5	99
794.6	100

For instance, according to this table 1 liter of 93 per cent. spirit of wine weighs 823.7 grammes; and, if the percentage of the spirit of wine is known, every account of spirit of wine can be easily changed into liter measure by the weight, and *vice versa*.

Ordinary Cabinet-maker's Polish.

	Parts.
Ruby shellac	10
Spirit of wine	40

This may be used for dark woods such as walnut, mahogany, etc.

English Polish.

Powder

250 grammes (8.75 ozs. avoird.) of the finest shellac and

60 grammes (2.1 ozs.) of dragon's blood,

and dissolve these substances in

750 grammes (26.25 ozs.) of 96 per cent. alcohol.

On the other hand,

60 grammes (2.1 ozs.) of powdered copal are placed in a glass, and

250 grammes (8.75 ozs.) of 96 per cent. alcohol are poured over it, and to this

180 grammes (6.3 ozs.) of fine chalk-powder are added.

The mass is then digested for several days in a sand-bath, the saturated solution of copal in alcohol is

added to the first solution; they are then intimately mixed by being heated, and finally filtered through a cloth.

Vienna Polish.

This consists of a solution of
180 grammes (6.3 ozs.) of finest shellac in
1.10 kilogrammes (2.42 lbs.) of 96 per ct. alcohol.

Dark-colored Polish.

300 grammes (10.5 ozs.) of ruby shellac, and
60 grammes (2.1 ozs.) of Venetian turpentine
are dissolved in
2 kilogrammes (4.4 lbs.) of 96 per ct. alcohol,
and filtered through blotting-paper.

Mahogany Polish.

This consists of a solution of
500 grammes (17.5 ozs.) of finest shellac in
1 kilogramme (2.2 lbs.) of 96 per cent. alcohol.
It is prepared in a water-bath.

French Polish.

This is composed of
120 grammes (4.2 ozs.) of finest shellac,
1.5 kilogrammes (3.3 lbs.) of 96 per cent. alcohol,
30 grammes (1.05 ozs.) of dragon's blood,
0.5 gramme (7.7 grains troy) of turmeric.

The powdered shellac is put in a glass vessel and dissolved by adding one-half of the prescribed quantity

of alcohol, and placing the vessel in a sand-bath ; the pulverized dragon's blood is dissolved with the other half of the alcohol. When all is dissolved the solutions are poured together, and then the turmeric is added. It is well shaken, the mass is allowed to stand quietly for twenty-four hours, and is then filtered.

This polish may also be used as a durable varnish upon copper.

White Cabinet-maker's Polish.

	Parts.
Completely bleached shellac . .	10
Spirit of wine	45 to 50

This colorless varnish may be used for light woods such as maple, ash, boxwood, etc., and is also employed by turners to give a beautiful, glossy appearance to their work.

Directions for Spirit of Wine Varnishes.

Shellac Varnish.

This varnish is used more than any other spirit varnish, and is especially employed for polishing wood (cabinet-maker's polish), for varnishing book-covers and other pasteboard and leather articles (bookbinder's and cartoon varnish), for coating the caps of bottles, and for making the so-called wash-gold frames (gold lacquer).

Good spirit varnishes must be free from the already mentioned faults ; they must neither crack nor scale.

The first is obtained by mixing suitable resins; to use a brittle resin by itself does not answer the purpose; the latter quality is obtained by applying the varnish not only with the brush but by rubbing it thoroughly into the wood, as is done, for instance by cabinet-makers in polishing with the polishing pad.

It is admissible to add a certain quantity of oil of turpentine varnish, or, still better, of fat copal varnish to such spirit varnishes as do not need to be absolutely colorless, and are not required to dry very quickly.

Spirit Varnish for Wood-work.

		Parts.
A.	Sandarac	40
	Venetian turpentine	4
	Spirit of wine	120
B.	Sandarac	24
	Venetian turpentine	2
	Mastic	16
	Spirit of wine	120
C.	Sandarac	48
	Venetian turpentine	1
	Mastic	24
	Spirits of wine	120

Pliable Sandarac Lac Varnish for Wood.

Sandarac	375	grams.	(13.12 ozs.)
Elemi	125	"	(4.37 ")
Animé	125	"	(4.37 ")
Camphor	30	"	(1.05 ")

These substances are powdered and put in a matrass. Then 1.25 kilogrammes (2.75 lbs.) of spirit of wine—96 per cent. strong—are poured over them. The resins are dissolved by placing the matrass in a water or sand-bath, and the solution is finally filtered.

The product thus obtained furnishes an excellent coat of varnish.

Sandarac Varnish for Furniture.

Sandarac . . .	375 grams.	(13.12 ozs.)
Mastic . . .	125 "	(4.37 ")

are powdered, and this powder is mixed with 250 grams. (8.75 ozs.) of powdered glass. It is then placed in a matrass, and 1 kilogramme (2.2 lbs.) of alcohol, 90 per cent. strong, is poured over it, and the solution is effected by a sand or water-bath. When the resins are dissolved, 60 grams of venetian turpentine are added, and the mass is then filtered through cotton.

English Red Furniture Varnish.

Sandarac . . .	200 grams.	(7 ozs.)
Refined shellac . .	125 "	(4.37 ")
Colophony . . .	125 "	(4.37 ")
Dragon's blood . .	30 "	(1.05 ")

are powdered, and 1.5 kilogrammes (3.3 lbs.) of alcohol poured over the powder. This is dissolved by placing the vessel containing it in a water or sand-bath. Then 20 grams (0.7 oz.) of venetian turpentine are added to the mass.

Dutch Furniture Varnish.

This consists of

Sandarac . . .	375 grams.	(13.12 ozs.)
Refined shellac . .	125 "	(4.37 ")
Colophony . . .	250 "	(8.75 ")
Venetian turpentine .	250 "	(8.75 ")
Alcohol . . .	2.5 kilos.	(5.5 lbs.)

The shellac is first dissolved in the alcohol. The solution is filtered, and then the other substances, which have been mixed with 250 grammes (8.75 ozs.) of powdered glass, are added to it. This lacquer is very good.

Lacquer for Basket and Wicker Work.

A lacquer which shall answer for this purpose must always possess a certain degree of elasticity, and can be prepared without great difficulty by the following process: Good linseed oil is boiled in a capacious vessel until one drop of it when poured upon a cold stone slab becomes so viscid that it strongly adheres to the finger when touched and can be drawn out in long threads. The twentieth part of this linseed oil is mixed with good, fat copal varnish, and then the lacquer is reduced with as much oil of turpentine as is required to bring it to the desired consistency. To color this lacquer if required, it is best to add aniline colors dissolved in benzol, and to mix the solution intimately with the lacquer.

Ebony Lacquer for Wood Work.

Aniline hydrochloride 10 grammes (0.35 oz.), spirit of wine 10 grammes (0.35 oz.). This solution is applied to the wood, which has been previously coated with a solution prepared from 1 part of blue vitriol and 100 parts of water. This coating must have become perfectly dry before the solution of the aniline salt is applied. It is best to apply the latter with a small soft sponge. A short time after this has been applied the wood will acquire a deep black color. This is effected by the action of the blue vitriol upon the aniline hydrochloride. This combination has been called nigrosin on account of its black color, and cannot be destroyed either by acids or alkalies. The wood can therefore be left without further coating, but if it is desired to give it a lustre a coating of ordinary cabinet-makers' varnish will be sufficient for the purpose.

Preparation of Chinese Varnish for Articles of Wood.

A kind of putty or mastic cement is prepared from gypsum, potters' clay, earthy common feldspar, and glue. When this mastic is dry it is carefully polished with sandstone; then the top-layer is coated with a black pigment dissolved in lac-varnish, and when this is dry a coat of lac-varnish is laid on. This lacquer is obtained from a tree called in China tsie chou, a kind of sumach, from which the juice exudes in the form of a gum. In a fluid state this lacquer is so poisonous as

to cause a painful swelling of the faces and hands of the workmen working with it. The lacquer is allowed to dry in the open air, and then the decorations are engraved upon it with a graving tool. The color or gold intended for the decorations is mixed with drying oil, and, when it has been laid on, the last coat of varnish is applied over all.

According to Macaire-Prinzep this varnish consists of

Benzoic acid,
Yellow resin,
Colorless volatile oil.

It has a brownish color, a peculiar, aromatic smell, and its taste resembles that of balsam of copaiba. It is of a viscid consistency like thick turpentine. When applied to wood Chinese varnish produces a very glossy coating, which dries easily and possesses great lustre. It can be dissolved in cold, but quicker, in boiling alcohol as well as in oil of turpentine.

Bookbinder's Varnish.

	Parts.
Elemi	4
Mastic	4
Sandarac	6
Venetian turpentine	3
Spirit of wine	30

Bookbinder's Lacquer A.

	Parts.
Shellac	10
Oil of turpentine	1
Spirit of wine	30

Bookbinder's Lacquer B.

	Parts.
Dragon's blood	1
Gamboge	10
Sandarac	2
Shellac	20
Venetian turpentine	5
Spirit of wine	100

Ordinary Brown Bookbinder's Lacquer.

120 grammes (4.2 ozs.) of brown shellac are dissolved in

1.75 kilogrammes (3.85 lbs.) of alcohol, 84 per cent. strong.

The solution is filtered, one-half of the alcohol is then evaporated or distilled off, and four grammes (0.14 oz.) of oil of lavender are added to the remaining fluids.

White Bookbinder's Lacquer.

This is prepared by dissolving

120 grammes (4.2 ozs.) of bleached shellac in

1.75 grammes (0.06 oz.) of alcohol, 92 per cent. strong.

The solution is filtered and reduced one-quarter by distillation, and then

4 grammes (0.14 oz.) of oil of lavender are added to it. This is a bookbinder's lacquer possessing excellent qualities.

Sohné Bros. Paris Brown Bookbinder's Lacquer.

This consists of

250 grams. (8.75 ozs.) of shellac,
15 grams. (0.525 oz.) of oil of lavender,
30 grams. (1.05 oz.) of gamboge, and
1.250 kilograms. (2.75 lbs.) of alcohol, 98 per cent. strong.

This lacquer is prepared in the same manner as the foregoing, and then 40 grammes (1.4 oz.) of brown bookbinder's lacquer of the same quality are added. Finally it is filtered from the bottom sediment.

New Bookbinder's Lacquers.

New Brown Bookbinder's Lacquer.

120 grams. (4.2 oz.) of refined shellac,
500 grams. (17.5 oz.) of wood spirit (methyl alcohol).

The shellac is put in a glass bottle, the wood spirit is poured over it, and the bottle is frequently shaken until the shellac is dissolved. 5 grammes (0.175 oz.) of oil of lavender are then added, and the solution is filtered through blotting paper.

In this manner a reddish-brown lacquer of good

consistency is obtained which gives a fine lustre to articles of leather, and is very durable.

New White Bookbinder's Lacquer.

180 grams. (6.3 oz.) of bleached shellac are put in a glass bottle, and

500 grams. (17.5 oz.) of wood spirit (methyl alcohol) are poured over it. This is frequently shaken until the shellac is dissolved. 5 grammes (0.175 oz.) of oil of lavender are then added, and the solution is filtered through blotting paper.

Volatile Copal Varnish A.

	Parts.
Copal	60
Ether	10
Alcohol	60
Oil of turpentine	40

Volatile Copal Varnish B.

	Parts.
Copal	10
Acetone	30

Acetone is only valuable in so far as it furnishes an excellent solvent for copal, but is of less use in the ready varnish, as it dries too quickly (acetone boils at 56° C., 132.8° F.); the clear solution is carefully distilled at a low temperature until about 15 to 20 parts of the acetone pass over. Then immediately after the distillation is interrupted, spirit of wine,

90 per cent. strong, is added to the warm, viscid solution. Ether may also be used instead of acetone. If this fluid is used, as much spirit of wine is at once put in the alembic as it is desired to distil off of ether. When this is heated to from 34° to 36° C. (93.2° to 96.8° F.), ether only passes over—in this case the cooling pipe of the distilling apparatus must be surrounded with ice—and the ether can be again used.

Elastic Copal Varnish C.

	Parts.
Camphor	1
Copal	4
Ether	12

This solution becomes clear only after standing a long time. It is allowed to stand for weeks in bottles, and the upper clear part is poured off. The sediment consists of the swelled-up copal, which has to be again treated with

	Parts.
Camphor	½ to ¾
Copal	2
Ether	12

Turner's Lacquer.

	Parts.
Elemi	2
Bleached shellac	10
Venetian turpentine	2
Spirit of wine	30

English Lac-Varnish for Boxes and Fancy Articles.

This is prepared by powdering

320 grams. (11.2 ozs.) of seed lac,
120 grams. (4.2 ozs.) of sandarac,
100 grams. (3.5 ozs.) of elemi resin.

These are mixed with

250 grams. (8.75 ozs.) of powdered glass,

and dissolved in a water bath in

1.5 kilograms. (3.3 lbs.) of 96 per cent. alcohol.

Then 120 grammes (4.2 ozs.) of turpentine which has been previously heated are added to the solution. The whole is intimately mixed together by shaking, and then filtered.

Latest Lac-Varnish for Turners.

60 grams. (2.1 ozs.) of shellac,
3 grams. (0.1 oz.) of mastic in grains,

are powdered, and absolute alcohol is poured over them, so that the alcohol stands about $1\frac{1}{2}$ inch above the substances. The mass is dissolved by being exposed to a gentle heat, and is then boiled down to the consistency of syrup.

The turned articles of wood or horn are thoroughly pumiced; they next receive a coat of linseed-oil, and are then coated with the above lac-varnish.

Varnish for Bottle-caps.

	Parts.
Gamboge	10
Ruby shellac	20
Venetian turpentine	5
Spirit of wine	100

Lacquer for Floors, A.

	Parts.
Colophony	10
Ruby shellac	20
Venetian turpentine	5
Spirit of wine	100

Lacquer for Floors, B.

	Parts.
Colophony	15
Ruby shellac	10
Oil of turpentine	5
Spirit of wine	60

Lacquer for Floors, C.

Shellac	150 grams. (5.25 ozs.)
Spirit of wine	2 liters (2.1 quarts).

This latter may be used for floors which have been first painted with any color desired. The thin coating of lacquer will make the color more durable than would be the case without it.

Bernarth's Lacquer for Floors.

500 grams. (17.5 ozs.) of shellac,
250 grams. (8.75 ozs.) of white colophony,
2 grams. (0.07 oz.) of camphor,

are pulverized and put into a bottle.

3 kilograms. (6.6 lbs.) of 96 per cent. alcohol are then poured over it. The bottle is placed in a warm place and frequently shaken, until the substances are dissolved. The solution is then filtered through a cloth.

This varnish must be heated when it is to be used. 500 grammes (17.5 ozs.) of this lac-varnish cover 36 square feet of floor surface.

By mixing

500 kilograms. (1100 lbs.) of pulverized and washed ochre with
1 kilogram. (2.2 lbs.) of this lacquer,

an excellent ground-lacquer for soft floors is obtained.

Varnish for Floors according to Monmory and Raphanel.

1 kilogram. (2.2 lbs.) of linseed oil

is heated for 16 hours, and

2.5 kilograms. (5.5 lbs.) of melted copal and
2 kilograms. (4.4 lbs.) of white resin

are dissolved in it. Then

1 kilogram. (2.2 lbs.) of sandarac,
3 kilograms. (6.6 lbs.) of bleached shellac,
500 grams. (17.5 ozs.) of mastic, and
500 grams. (17.5 ozs.) of dammar resin,

are added to it. The entire mass is boiled for three hours, and is then mixed with

10 kilograms. (22 lbs.) of alcohol 90 per cent. strong.

When all has been dissolved, the entire mass is strained through a hair sieve, and it is then compounded with the color the floor is to have. The varnish is applied to the floor with a brush, which should first have been well cleansed, and a second coat is laid on in about two hours. This varnish possesses much lustre, and can be easily cleansed with a moist sponge. Should it become dull in the course of time, it is lightly rubbed with a rag dipped in linseed-oil. This varnish may also be used for wainscoting walls, etc.; but for such purposes

1 kilogram. (2.2 lbs.) of elemi resin

is added to it.

Stain for Floors.

250 grams. (8.75 ozs.) of fustic (yellow wood) and
120 grams. (4.2 ozs.) of logwood

are boiled with

24 kilograms. (52.8 lbs.) of soap-boiler's lye, and
120 grams. (4.2 ozs.) of potash,

until 12 liters (3.17 gals.) of the fluid remain. The solution is then poured off, and

30 grams. (1.05 ozs.) of annotto and
750 grams. (26.25 ozs.) of wax

are dissolved in it while it is still hot. The mixture is then stirred until it is cold. Eight to ten bottles of brownish-red stain are obtained; a quantity sufficient

to supply a large room for one year. The floor is swept every day with a hair-broom, and wiped up once every week with a half-moist cloth, and some of the stain is applied to those places much walked over, and thoroughly rubbed in with a sharp brush. Every four to six weeks the entire floor is painted with the stain by using a brush, and at once rubbed in with a sharp brush.

Varnish for Imitation Gilt Cornices.

Shellac . . .	1500 grams.	(52.5 ozs.)
Spirit of wine . .	3 liters	(3.15 qts.)

This solution is prepared by itself, and cleared by allowing it to settle.

Sandarac . . .	250 grams.	(8.75 ozs.)
Mastic . . .	200 "	(7 ")
Gamboge . . .	250 "	(8.75 ")
Dragon's-blood . .	50 "	(1.75 ")

This solution is mixed with the clear shellac solution. There is left considerable choice in regard to the color. If a light gold is to be produced, the mentioned quantity of dragon's-blood will be sufficient. But, if it is desired to give to the varnish a shade inclining more towards reddish, a larger quantity of dragon's-blood has to be used.

In manufacturing these varnishes, it is especially convenient to prepare the solutions of the gamboge and dragon's-blood separately: the required shade of color can then be given to the varnish without any

great difficulty by adding one or the other solution as may be needed.

Dead Ground for Imitation Gilt Frames.

Bleached shellac	250 grams.	(8.75 ozs.)
Whiting	250 "	(8.75 ")
Spirit of wine	2 liters	(2.1 qts.)

This varnish is prepared by first dissolving the shellac in as small a quantity of spirit of wine as possible; this is then quickly rubbed together with the whiting into a dough, and the remainder of the spirit of wine is gradually added. If the varnish should have a glossy appearance after it has become dry, some alcohol and whiting are added, but should it be too dead, a small portion of a thick solution of shellac has to be added. Finally, it receives a thin coat of a colorless solution of shellac.

Varnish for Gilt Cornices.

Shellac	1200 grams.	(42. ozs.)
Sandarac	500 "	(17.5 ")
Gamboge	250 "	(8.75 ")
Sanders-wood	200 "	(7 ")
Turpentine	150 "	(5.25 ")
Alcohol	5 liters	(5.25 qts.)

The sanders-wood is treated by itself with a part of the alcohol, and the solution is added to the other components of the varnish.

Colored Varnishes with Gold-Lustre for Frame-Mouldings.

Such varnishes can be easily prepared by adding to a thick solution of shellac a corresponding quantity of any aniline coloring matter which has been dissolved in spirit of wine, and red, blue, violet, and green shades of color may be produced; after the aniline varnish has become dry, the articles receive a coat of a colorless varnish.

Gold Lacquer A.

	Parts.
Dragon's-blood	1.5
Gamboge	3
Mastic	4
Saffron	1
Sandarac	4
Shellac	20
Spirit of wine	100

Gold Lacquer B.

	Parts.
Turmeric	5
Dragon's-blood	1
Elemi	2
Gamboge	3
Seed-lac	10
Mastic	10
Sandarac	10
Venetian turpentine	5
Spirit of wine	100

Gold Lac-Varnish A.

	Parts.
Gamboge	10
Mastic	25
Seed-lac	25
Saffron	1
Spirit of wine	150

Gold Lac-Varnish B.

	Parts.
Turmeric	1.5
Dragon's-blood	20
Elemi	30
Gamboge	20
Seed-lac	20
Sandarac	50
Spirit of wine	50

English Durable Gold Lac-Varnish.

1 kilogram. (2.2 lbs.) of 96 per cent. alcohol is poured over

500 grams. (17.5 ozs.) of powdered stick-lac and dissolved by placing the vessel containing the mixture in a water-bath. The ready lac-varnish is then filtered through blotting paper.

Thompson's Gold Lac-Varnish.

This is prepared by powdering

120 grams. (4.2 ozs.) of gamboge,
120 grams. (4.2 ozs.) of stick-lac,

120 grams. (4.2 ozs.) of annotto,
120 grams. (4.2 ozs.) of dragon's-blood,
30 grams. (1.05 ozs.) of saffron.

Each powdered article is placed by itself in a glass bottle, and 1 kilogramme (2.2 lbs.) of 96 per cent. alcohol is poured over each. They are then allowed to stand for fourteen days, either in the sun or a warm place, and are frequently shaken until everything has been dissolved; then

120 grams. (4.2 ozs.) of hot Venetian turpentine are added, and the solutions are filtered through linen, and either poured all together, or only parts of them, according as the lac-varnish is desired.

Amber Gold Lac-Varnish.

120 grams. (4.2 ozs.) of stick-lac,
30 grams. (1.05 ozs.) of yellow, transparent amber,
40 grams. (1.4 ozs.) of refined sandarac,
30 grams. (1.05 ozs.) of mastic in grains,
90 grams. (3.15 ozs.) of pure light-yellow colophony,
30 grams. (1.05 ozs.) of dragon's-blood,
30 grams. (1.05 ozs.) of turmeric, and
30 grams. (1.05 ozs.) of gamboge,

are powdered and put in a suitable alembic.

2 kilograms. (4.4 lbs.) of 96 per cent. alcohol are then poured over the powdered substances, and they are dissolved by placing the alembic in a water-bath. The solution is then filtered through a cloth.

The varnish, as well as the article to be varnished, must be heated before the varnish is laid on.

Mixed Gold Lac-Varnish.

This consists of

280 grams. (9.8 ozs.) refined sandarac,
100 grams. (3.5 ozs.) pure light-colored copal,
60 grams. (2.1 ozs.) stick-lac,
2 kilograms. (4.4 lbs.) 96 per cent. alcohol,
15 grams. (0.52 ozs.) turmeric,
30 grams. (1.05 ozs.) gamboge,
250 grams. (8.75 ozs.) 96 per cent. alcohol.

The sandarac, copal, and stick-lac are powdered and dissolved in the alcohol; the dissolving is effected by a water-bath. The coloring substances are also powdered and each one by itself is dissolved in

60 grams. (2.1 ozs.) of 96 per cent. alcohol,

then filtered and added to the lac-varnish.

Varnish for Gilt Mouldings.

	Parts.
Amber	25
Dragon's-blood	20
Gamboge	25
Seed-lac	100
Saffron	1
Sanders-wood	3
Spirit of wine	500

This varnish must stand for some time, and must then be filtered. It is better to treat the coloring

matter, the sanders-wood, and the saffron by themselves with spirit of wine, and to add the solution to the ready varnishes. A test of all the varnishes for gilt mouldings and gold-lacquer varnishes can be easily made by rubbing a small quantity of the varnish upon a piece of bright tin-plate. When this dries, the golden lustre will make its appearance. If a warmer shade of gold is required, one more inclined to reddish, a larger quantity of the red coloring substances must be used, but more yellow if a pale gold is desired.

Glossy Lacquer.

	Parts.
Amber	2
Copal	4
Seed-lac	6
Mastic	5
Sandarac	5
Shellac	10
Venetian turpentine	4
Spirit of wine	100

Wessner's Quickly-drying Glossy Lac-Varnish.

This is prepared by powdering

375 grams. (13.125 ozs.) of refined sandarac.

This powder is dissolved in

950 grams. (33.25 ozs.) of 96 per cent. alcohol

by placing the vessel containing it in a water or sand bath. Then

200 grams. (7 ozs.) of Venetian turpentine

are added to the solution, and when the mass has been intimately mixed together, the ready lac-varnish is filtered.

English Glossy Lac-Varnish.

This is composed of

375 grams. (13.125 ozs.) of refined and powdered sandarac,

110 grams. (3.85 ozs.) of Venetian turpentine, and

950 grams. (33.25 ozs.) of 96 per cent. alcohol.

This is prepared in the same manner as the foregoing, and is kept in well-closed bottles. This lac-varnish is very glossy, but does not dry very quickly.

Resin Lacquer A.

	Parts.
Colophony	20
Elemi	5
Spirit of wine	60

Resin Lacquer B.

	Parts.
Colophony	25
Mastic	5
Shellac	5
Spirit of wine	150

Wood-Lacquer (Red).

	Parts.
Dragon's-blood	1
Elemi	2
Mastic	2
Sandarac	8
Shellac	4
Venetian turpentine	4
Spirit of wine	50

Wood-Lacquer (Black).

	Parts.
Elemi	1
Seed-lac	1
Mastic	1
Sandarac	1
Shellac	2
Venetian turpentine	1
Spirit of wine	20
Colored with bone-black	1

Which is rubbed in with the turpentine and added to the solution of resin.

Lacquer for Comb-makers.

	Parts.
Elemi	2
Mastic	2
Shellac	10
Spirit of wine	40

Lacquer for Tinsmiths.

	Parts.
Elemi	2
Seed-lac	10
Sandarac	5
Venetian turpentine	3
Spirit of wine	60

Lacquer for Copper-plates.

	Parts.
Camphor	2
Mastic	2
Sandarac	5
Bleached shellac	5
Spirit of wine	80

French Sandarac Lac-Varnish.

375 grams. (13.125 ozs.) of sandarac,
250 grams. (8.75 ozs.) of elemi resin,
125 grams. (4.375 ozs.) of animé resin,
36 grams. (1.26 ozs.) of camphor,
are put in an alembic.

950 grams. (33.25 ozs.) of 96 per cent. alcohol are then poured over them, and the resins are dissolved by placing the alembic in a water-bath.

To prevent the powdered resins from caking together,

250 grams. (8.75 ozs.) of powdered glass are added to them.

Another Receipt.

This consists of

250 grams. (8.75 ozs.) of sandarac,
125 grams. (4.375 ozs.) of colophony,
60 grams. (2.1 ozs.) of refined shellac,
150 grams. (5.25 ozs.) of Venetian turpentine,
1 kilogram. (2.2 lbs.) alcohol (96 per cent.)

It is prepared in the same manner as the foregoing.

French Sandarac Varnish for Artists.

This consists of

250 grams. (8.75 ozs.) sandarac,
250 grams. (8.75 ozs.) mastic in grains,
125 grams. (4.375 ozs.) Venetian turpentine,
1 kilogram. (2.2 lbs.) 96 per cent. alcohol.

The resins are dissolved by placing the vessel containing them in a water-bath, and, to prevent caking,
200 grams. (7 ozs.) of powdered glass are added to them.

Dutch Varnish for Artists.

250 grams. (8.75 ozs.) of refined sandarac,
250 grams. (8.75 ozs.) of mastic in grains,
125 grams. 4.375 ozs.) of animé resin,

are powdered and dissolved in
1.5 kilogram. (3.3 lbs.) of 96 per cent. alcohol,
by placing the vessel containing them in a water-bath. The solution is then filtered.

Lac-Varnish for Water-color Pictures.

Take

200 grams. (7 ozs.) refined sandarac,

30 grams. (1.05 ozs.) of mastic in grains,

powder them, and dissolve them in

500 grams. (17.5 ozs.) of 96 per cent. alcohol.

Then

60 grams. (2.1 ozs.) of Venetian turpentine

are added, and the solution is filtered.

Lacquer for Dark Wall-Paper.

Wall-paper coated with the following lacquer can be washed with soap and water without suffering injury:—

Borax . .	30 grams. (1.05 ozs.)
Shellac or stick-lac	30 grams. (1.05 ozs.)

are dissolved in 300 grammes (10.5 ozs.) of hot water. The solution is then strained through a close cloth, and the lacquer is applied to the wall-paper either before or after it is put on the wall. When dry the paper is brushed with a soft brush, which will give it a fine lustre. The paper should receive two coats, which are applied in the usual manner with a brush; but of course the first coat should be thoroughly dry before the second is laid on.

Lacquer for Light Wall-Paper.

This is prepared in the same manner as the above, except that the same quantity of sandarac is substituted for the shellac.

Insoluble Varnishes for Copper-plates and Maps.

When copper-plate engravings, maps, and paper in general are to be coated with a thin layer impervious to water, but nevertheless elastic, the following process is used: Fine gilder's glue is dissolved in water in the proportion of 50 grammes (1.75 ozs.) of glue to 1 liter (2.1 pints) of water, the warm solution is applied to the surface of the paper, and this is allowed to dry thoroughly. After the paper has become dry, it is laid in a solution of acetate of alumina and allowed to remain there for one hour. The paper is then washed off, dried, and smoothed. A coating of alumina and glue has thus been formed upon the paper, a process which is called tawing. Such a paper can be washed with a damp sponge without suffering injury.

Mastic Varnish A.

	Parts.
Mastic	4 to 5
Sandarac	5 to 6
Venetian turpentine	½ to ¾
Spirit of wine	26 to 30

Mastic Varnish B.

	Parts.
Mastic	5 to 6
Sandarac	10 to 12
Venetian turpentine	¼ to ½
Spirit of wine	26 to 30

Very Transparent Mastic Varnish for Oil-Paintings.

This consists of

360 grams. (12.6 ozs.) of the finest mastic,
50 grams. (1.75 ozs.) of Venetian turpentine,
15 grams. (0.525 oz.) of camphor,
230 grams. (8.05 ozs.) of rectified French oil of turpentine,
1 kilogram. (2.2 lbs.) of 96 per cent. alcohol.

It is prepared in a water bath.

Held's Mastic Varnish for Articles of Pasteboard.

360 grams. (12.6 ozs.) of mastic, in grains, and
180 grams. (6.3 ozs.) of refined sandarac,

are powdered, and these substances are mixed with

200 grams. (7 ozs.) of powdered glass.

They are then dissolved in

2 kilograms. (4.4 lbs.) of 96 per cent. alcohol,

and then

200 grams. (7 ozs.) of Venetian turpentine, which has been previously liquefied, are added to the solution. The entire mass is intimately mixed together by shaking it thoroughly, and finally is filtered through a cloth.

Lacquer for Brass.

	Parts.
Seed-lac	1
Shellac	1
Venetian turpentine	0.5
Spirit of wine	20

Varnish for Metals (Colorless).

	Parts.
Amber	1
Mastic	1
Sandarac	2
Bleached shellac	2
Spirit of wine	20

Varnishes for Photographers.

Photographers require for their work a lacquer which must possess peculiar properties. On the one hand, it must be entirely colorless, must adhere tightly to the glass, and be as hard as possible; and on the other, it must be so constituted as to allow of the plate being retouched with a lead-pencil. The most important property required of these lacquers is hardness, as only in cases where the glass negative is coated with a hard varnish is it possible to take many copies without injury to the plate; and finally it should be mentioned that these lacquers must also possess a certain degree of elasticity, and must not crack when the lacquered plate is laid away, as this would be equivalent to a complete spoiling of the photographic negative. As will be seen, quite contradictory properties—hardness and elasticity—are demanded for such varnish, and it is scarcely possible to give equal satisfaction with respect to both of them. Of the many directions which might have been given for preparing photograph varnishes, we furnish only those which have stood the test after many years of experiment.

Varnish for Photographic Negatives.

	Parts.
Sandarac	4
Spirit of wine	20
Chloroform	0.5
Oil of lavender	3

The filtered solution is spread out by pouring it over the glass plate and dried by applying heat. The coating is perfectly colorless, and negatives coated with this varnish do not crack, even if they are stored away for a long time.

Monkhoven's Retouching Varnish for Negatives.

Shellac is placed for 24 hours in a saturated solution of carbonate of ammonia in water. The solution is then poured off and replaced by an equal quantity of pure water; the fluid is boiled under constant stirring until a complete dissolution has taken place. The proportion between shellac and water should be as 1 : 8. This is poured twice in succession over the negative, which must be thoroughly dry. Retouching can be done more quickly and finer upon this coating than upon any other.

Retouching Varnish for Photographs.

Shellac	1 gram.	(0.035 oz.)
Sandarac	6 "	(0.21 oz.)
Mastic	6 "	(0.21 oz.)
Ether	10 cubic centimetres	(2.7 fl. dr.)

Ten cubic centimetres (2.7 fl. dr.) of pure benzole are added to the mixture after the resins have dissolved in the ether.

Elastic Dammar Lacquer for Photographs.

Dammar . .	40	grams.	(1.4 ozs.)
Acetone . .	180	"	(6.3 ozs.)

The resin will be almost completely dissolved in 14 days if the well-closed bottle containing the substance is allowed to stand in a moderately warm place. The solution is then carefully poured off from the residuum. The lacquer should be applied with a soft brush, and the application should be repeated several times.

Hard Lacquer for Photographic Negatives.

Sandarac . .	200	grams.	(7 ozs.)
Venetian turpentine	20	"	(0.7 oz.)
Oil of lavender .	25	"	(0.875 oz.)
Ether . . .	25	"	(0.875 oz.)
Absolute alcohol .	500	"	(17.5 ozs.)

Photographer's Lacquer A.

	Parts.
Mastic	2
Bleached shellac	10
Oil of turpentine	2
Spirit of wine	60

Photographer's Lacquer B.

	Parts.
Amber	1
Copal	1
Benzole	2
Spirit of wine	15

Photographer's Lacquer C.

	Parts.
Amber	2
Copal	2
Mastic	1
Petroleum naphtha	10
Spirit of wine	20

The raw materials for preparing lacquers for photographers must be chosen with the utmost care, as it is absolutely necessary that these lacquers should be entirely colorless.

Lacquers for Leather.

Black Lacquer for Leather A.

Shellac	10 grams.	(0.35 oz.)
Turpentine	50 "	(1.75 ozs.)
Spirit of wine	400 "	(14 ozs.)

Five grammes (0.175 oz.) of extract of logwood should first be dissolved in the spirit of wine, and a solution of 1 gramme (0.035 oz.) of bichromate of potassa is added to this. The two last-named substances produce an intensely black color, and the lacquer will

show a glossy black color immediately after having become dry. If a color with a bluish tinge is desired, that object is obtained in the simplest manner by dissolving from 5 to 10 grammes (0.175 to 0.35 oz.) of indigo-carmine in the ready lacquer.

Black Lacquer for Leather, B.

	Parts.
Ruby shellac	50
Venetian turpentine	1
Sandarac	1
Castor oil	1
Spirit of wine	150
Aniline black	5

Black Lacquer for Leather, C.

10 kilograms. (22 lbs.) of water,
2 kilograms. (4.4 lbs.) of borax,
2 kilograms. (4.4 lbs.) of shellac,

are boiled together. On the other hand,

2 kilograms. (4.4 lbs.) of logwood are boiled in
2 kilograms. (4.4 lbs.) of water,

and

1 kilogram. (2.2 lbs.) of green vitriol in
1½ kilogram. (3.3 lbs.) of water.

The shellac solution is added to this, and intimately mixed with it.

This lacquer has a greenish color, but very quickly turns black when it is applied to leather.

Bronze-colored Shoe Lacquer.

½ kilogram. (1.1 lbs.) of shellac and
80 grams. (2.8 ozs.) of aniline blue
or aniline red are dissolved in
2 kilograms. (4.4 lbs.) of water,
according as a greenish or brownish gloss is desired.

Cheap Glossy Lacquer for Leather.

	Parts.
Black pitch	1
Benzole	4

The solution is accomplished by heat, and the lacquer, which dries quickly, is very well adapted for lacquering shoe-leather, as it retains a certain elasticity. If it is desired to still further increase the latter property, a few per cents. of turpentine may be added to the solution.

Lacquer for Harness-makers.

	Parts.
Colophony	5
Lampblack	1
Mastic	2
Sandarac	5
Shellac	20
Venetian turpentine	5
Spirit of wine	100

Sandarac Varnish.

	Parts.
Sandarac	10
Venetian turpentine	1 to 2
Spirit of wine	26 to 30

Lacquer for Terra Cotta.

	Parts.
Mastic	2
Shellac	20
Venetian turpentine	5
Spirit of wine	60

Universal Varnish (elastic).

	Parts.
Camphor	1
Colophony	2
Mastic	2
Sandarac	4
Spirit of wine	24

Universal Varnish (hard).

	Parts.
Camphor	2
Colophony	2
Mastic	2
Sandarac	2
Shellac	2
Spirit of wine	24

Varnish for Gilders.

	Parts.
Elemi	6
Mastic	6
Sandarac	12
Spirit of wine	300

Lacquer for Gilt Articles.

	Parts.
Amber	2
Dragon's-blood	0.5
Gamboge	0.5
Seed-lac	5
Sanders-wood	0.5
Sandarac	2
Saffron	0.2
Spirit of wine	20

Vernis d'Or (Gold Varnish).

	Parts.
Dragon's-blood	5
Elemi	5
Gamboge	25
Mastic	20
Sandarac	12
Shellac	20
Sanders-wood	15
Venetian turpentine	10
Spirit of wine	600

Each of the resins is dissolved by itself in the spirit of wine, and the coloring substances are digested in

spirit of wine ; the mass is filtered after the substances have been mixed together. This varnish possesses the property of elasticity in a very high degree, on account of its containing elemi, mastic, and especially turpentine, and can be used even for leather, oil-cloth, etc., as the coating will not crack, even if the articles to which it is applied are bent.

Directions for Oil of Turpentine Varnishes.

In the main, oil of turpentine varnishes are prepared in the same manner as the spirit varnishes; but on account of the higher boiling point of the oil of turpentine, it is not necessary to use the same precautions against the evaporation of the solvent as are required when spirit of wine is used. Resins can be very well dissolved in oil of turpentine, by placing them in a linen bag which is suspended by a string in a bottle four-fifths filled with oil of turpentine, and placed up to about a quarter of its height in sand piled upon the plates of an ordinary stove. A glass funnel containing a sponge, which has to be moistened from time to time, is placed upon the bottle. The loss of oil caused by evaporation is so small that it need not be taken into consideration.

Dammar Varnish.

	Parts.
Dammar resin	40 to 45
Oil of turpentine . . .	50 to 60

The preparation of this varnish requires a peculiar treatment, namely, dammar resin can only be dissolved

in oil of turpentine when this contains no water. If water is present, the resin is absolutely insoluble. According to an old irrational process, by which a large quantity of oil is lost by evaporation, and which, besides, is very dangerous on account of fire, the resin is heated in the oil until this no longer throws up bubbles, which are caused by the water vapor, but shows a smooth surface at a temperature of 120° to 130° C. (248° to 266° F.).

We proceed in the following manner: The resin, which has been previously heated for a short time to a temperature of 105° to 110° C. (221° to 230° F.), is then heated with a very small quantity of oil of turpentine, to bring the latter to the boiling point. This will form a very thick solution, furnishing at once ready varnish when reduced with a sufficient quantity of oil of turpentine.

Dammar Varnish (Mixed).

	Parts.
Dammar resin	80
Linseed oil	4 to 5
Oil of turpentine	100

The linseed oil is boiled for a few hours with the resin and a little oil of turpentine; although the varnish obtained in this manner is not quite so light as that with oil of turpentine alone, it can be laid on with less difficulty.

Dammar and Copal Varnish.

	Parts.
Copal	40
Dammar resin	80
Linseed oil	10
Oil of turpentine	100

The linseed oil is divided into two portions, the copal is dissolved in one portion, the dammar resin in the other, the solutions are poured together and reduced with oil of turpentine.

Amber and Elemi Lacquer.

	Parts.
Amber	20
Elemi	5
Venetian turpentine	5
Oil of turpentine	60

Lacquer for Sheet Metal.

	Parts.
Asphaltum	10
Colophony	5
Oil of turpentine varnish	20
Oil of turpentine	8

Copal Lacquer for Bookbinders.

	Parts.
West Indian copal	10
Mastic	2
Oil of turpentine	10
Spirit of wine	10

Gold Lacquer (Mixed).

	Parts.
Colophony	2
Gamboge	5
Mastic	5
Sandarac	5
Shellac	2
Turpentine	2
Oil of turpentine	50
Spirit of wine	10

The colophony, gamboge, mastic, sandarac, and shellac are dissolved in the spirit of wine, the turpentine in the oil of turpentine, and then the solutions are mixed together.

Held's Gold Lac Varnish.

The following ingredients are powdered:—

60 grams. (2.1 ozs.) of shellac,
60 grams. (2.1 ozs.) of aloes,
30 grams. (1.05 ozs.) of amber,
30 grams. (1.05 ozs.) of sandarac,
8 grams. (0.28 oz.) of gamboge,
4 grams. (0.14 oz.) of dragon's-blood.

They are then dissolved in—

500 grams. (17.5 ozs.) of oil of turpentine,

by placing the glass vessel containing them in a sand-bath.

If it is desired to make this varnish more durable, from 60 to 125 grammes (2.1 to 4.375 ozs.) of linseed

oil varnish are added to it, and the entire mass is allowed to boil up once more, and is finally filtered.

Gold Lac Varnish for Leather and Metal.

This consists of—

250 grams. (8.75 ozs.) of seed-lac,
250 grams. (8.75 ozs.) of sandarac,
98 grams. (3.43 ozs.) of gamboge,
16 grams. (0.56 oz.) of Venetian turpentine,
2 grams. (0.07 oz.) of oil of turpentine.

This is prepared in exactly the same manner as the foregoing, and is finally filtered.

Freudenwoll's Gold Lac Varnish.

This consists of a solution of—

125 grams. (4.375 ozs.) of gamboge,
125 grams. (4.375 ozs.) of dragon's-blood,
125 grams. (4.375 ozs.) of aloes, in
750 grams. (26.25 ozs.) of oil of turpentine,

and then a sufficient quantity of a cheap copal varnish or dammar varnish is added until the desired gold color has been obtained.

Dutch Gold Varnish.

125 grams. (4.375 ozs.) of mastic,
125 grams. (4.375 ozs.) of sandarac,
30 grams. (1.05 ozs.) of colophony,
60 grams. (2.1 ozs.) of aloes,

are powdered. They are then placed in a glass vessel, and dissolved in

200 grams. (7 ozs.) of oleum spicæ,

by placing the vessel in a water-bath. Then

8 grams. (0.28 oz.) of Venetian turpentine

are added to the solution, and this is then filtered.

This varnish may be laid warm and very thin on polished tin, and will produce a beautiful gold color. Wood, leather, etc., upon which silver leaf has been fastened with the white of an egg, can be beautifully gilt with this varnish.

Lacquers for Carriages.

	Parts.
East India copal	2
Oil of turpentine	3
Linseed oil	3

Neil's Carriage Lacquers.

I.

0.5 kilogram. (1.1 lb.) of fine African copal is melted, and to this are gradually added

2.5 kilograms. (5.5 lbs.) of old refined linseed oil, and this is boiled for four or five hours until it can be spun between the fingers; it is then reduced with

1.5 kilograms. (3.3 lbs.) of oil of turpentine, and filtered.

II.

Take

0.5 kilogram. (1.1 lb.) of animé resin, melt it, and add

1.25 kilograms. (2.75 lbs.) of linseed oil. This

is also boiled for four or five hours until the lacquer can be drawn into threads between the fingers, and is then reduced with

1.75 kilogram. (3.85 lbs.) of oil of turpentine, and filtered.

The lacquer I. does not dry very quickly, but, if this is desired, equal parts of the described lacquers I. and II. are taken and mixed intimately together by heating and constantly stirring them. It is then filtered once more. The lacquer mixed in this manner dries more quickly, and can be polished, while the pure copal varnish is more fluid, softer, and more pliant. The first possesses the quality of not changing its color after it has been applied, but the second becomes darker. For this reason it is advisable not to mix any drying substance with the linseed oil, as this always makes the color darker.

Dark Carriage Lacquer.

I.

0.5 kilogram. (1.1 lb.) of the best African copal is melted, and to this are added

1.25 kilogram. (2.75 lbs.) of refined linseed oil and

60 grams. (2.1 ozs.) of dried sugar of lead. It is then boiled until the varnish commences to draw threads between the fingers, and is then reduced with

1.5 kilogram. (3.3 lbs.) of oil of turpentine, and filtered.

II.

0.5 kilogram. (1.1 lb.) of pale animé resin is melted, and to this are added

1 kilogram. (2.2 lbs.) of refined linseed oil and

15 grams. (0.525 oz.) of white dried sulphate of zinc. This is then boiled for three or four hours until the varnish commences to be viscid, and is then reduced with

1.5 kilograms. (3.3 lbs.) of oil of turpentine, and filtered.

The two foregoing varnishes are intimately mixed together by being heated and filtered. The varnish obtained in this manner dries very quickly, but is not so durable as pure copal varnish.

Another Receipt.

0.5 kilogram. (1.1 lb.) of African copal is melted, and

1.5 kilograms. (3.3 lbs.) of refined linseed oil and

15 grams. (0.525 oz.) of litharge are added to this. It is then reduced with

0.5 kilogram. (1.1 lb.) of oil of turpentine, which has been previously heated, and the mixture is then filtered.

Water-proof Caoutchouc Lacquer.

The caoutchouc is dissolved by heating it for a considerable time with linseed oil. The solution is poured into tall bottles and allowed to stand for a few weeks

to become clear. The clear solution can then be rubbed together with any kind of mineral color, and furnishes a coating which will excellently resist the influence of the weather. When finely divided graphite is used instead of mineral color, a mass is obtained which in a dry state will have the appearance of steel.

Resin Lacquer (Fat).

	Parts.
Asphaltum	5
Colophony	20
Oil of turpentine	10
Linseed oil varnish	15

Lacquer for Sign Painters.

	Parts.
Elemi	4
Mastic	5
Sandarac	10
Shellac	10
Oil of turpentine	4
Venetian turpentine	4
Spirit of wine	100

Glazes for Barrels.

A great number of varnishes are brought into the market under the name of barrel glazes and barrel lacquers, which are of special importance for coating the fermenting tuns of breweries, and which are prepared as a specialty by some manufacturers. In the

following, we give two directions for preparing varnishes which have actually stood *a practical test.*

Dammar for Barrel Glaze.

Shellac . . .	100 grams.	(3.5 ozs.)
Dammar . . .	100 "	(3.5 ")
Spirit of wine . .	2 liters	(2.1 qts.)

The resins are digested in the spirit of wine in a well-closed bottle, which should be put in a warm place, until the greater part of them has been dissolved. The bottle should be frequently shaken. The glaze is ready for use when finally a turbid fluid has been formed. It is entirely unnecessary to filter it. The barrels to be glazed should be entirely dry, and it is advisable to dry them out and heat them by a current of hot air. A coat of lacquer is then quickly applied and is set on fire when it has dried so far that it no longer runs. When it burns brightly, the lid of the barrel is placed tightly upon it to extinguish the fire, and the barrel is allowed to cool off with the lid on. A thin layer of the glaze will remain adhering so tightly to the sides of the barrel, that it will never crack off.

Glaze for the Insides of Barrels.

Shellac . . .	200 grams.	(7 ozs.)
Dammar resin . .	200 "	(7 ")
Colophony . .	400 "	(14 ")
Spirit of wine . .	3 liters	(3.15 qts.)

The resins are dissolved in the spirit of wine in a closed vessel by applying heat, and the solution is used in a warm state. If barrels which have been previously glazed are to be coated again with the glaze, it is advisable not to allow the new coating to dry, but to set the glaze on fire and quickly place the lid upon the barrel. The old coating will then melt together with the new into a uniform, very tightly adhering mass.

Varnishes with Coal Tar Oil.

Since the immense development of that branch of industry devoted to the dry distillation of coal, many experiments have been made in using the oils, which can be gained from the tar, for the fabrication of varnishes also. And some of these oily products (in regard to their chemical composition, they do not belong to the actual oils, but to the hydron-carbon compounds) have been successfully used for the fabrication of varnishes and lacquers, and these lacquers are becoming of ever-increasing importance in our industry on account of their excellent qualities, and of the low price at which they can be produced. But we would here draw particular attention to the fact, that tar-oils can only be used for the fabrication of lacquers after they have been especially purified for the purpose.

Among the tar oils gained in rectifying coal tar, only those having a density of from 0.85 to 0.89 can be used for our purposes. These oils contain, when in a raw condition, a considerable quantity of foreign

substances, which would exert a disturbing influence upon the fabrication of varnishes, and it is, therefore, absolutely necessary to remove them. The oils are purified in the following manner:—

100 kilograms. (220 lbs.) of the raw oil are placed in a vat lined with thin plates of lead, and

Bichromate of potassa, 500 grams. (17.5 ozs.),
Powdered pyrolusite, 250 grams. (8.75 ozs.),
Sulphuric acid, 2 kilograms. (4.4 lbs.),

are added to them.

When these substances have been added, the fluid, which assumes a black color, is thoroughly stirred, and is then allowed to stand quietly for about six hours. Dark-colored, resinous products will be separated on the bottom of the vessel. These are removed, and the oil is subjected to washing. For this purpose the oil is drawn off from the sediment on the bottom, is washed first with warm water, and then treated with weak lye to remove the last traces of acid.

Special attention must be paid to removing the least trace of free acid, or else the oil suffers injurious changes. The purified oil is then distilled once more, and the density of the fluid passing over observed. As long as the density is below 0.88 the distillate, consisting of almost pure benzole, which is especially well adapted for dissolving certain resins, is removed, and the oil actually suitable for varnishes, which must have a density of at least 0.88, is caught by itself.

The oil suitable for varnishes is as clear as water, and its special superiority lies in the fact that it re-

mains entirely unchanged when exposed to the air and light. This oil is particularly well suited for dissolving light-colored resins, and, therefore, may be used for such varnishes as are specially required to be as colorless as possible. Excellent qualities of solutions of copal, sandarac, and mastic can be prepared with the assistance of these oils.

Varnishes prepared with tar oil are used for very different purposes, and for the sake of brevity we will, therefore, always use the term tar-varnish oil for these oils.

Colorless Negative Varnish.

	Parts.
Dammar	2
Mastic	1
Sandarac	0.5
Chloroform	20
Tar-varnish oil	20

For preparing this varnish the finely-powdered resins are tied in a small linen bag and suspended from the lower part of the cork into a bottle containing the corresponding quantity of fluids. The solution will be accomplished in a short time if the bottle is put in a moderately warm place. After the resins have been dissolved, the clear varnish is poured off from the uncommonly small quantity of sediment. The process of lacquering the plates with the varnish is very quickly accomplished, as the solvent shows great volatility.

Excellent Asphaltum and Amber Varnish, by Landerer.

Bottles of hyalite glass are generally used to protect medicines or other easily decomposing substances against the effect of light; but if such bottles cannot be had, it becomes necessary to paste black paper over them, or to coat them with a black varnish.

To prepare the latter asphaltum is dissolved in tar oil. The bottles may be coated either thick or thin, as may be desired, with this excellent black varnish, and the coating will dry in a few minutes, especially when the bottles to which it has been applied are placed in the sun or near a warm stove.

A varnish which is just as beautiful and dries as quickly can by prepared by dissolving common amber, which has first been melted, in chloroform. If this solution is poured into a glass, or a glass vessel is coated with it, it dries and leaves a beautiful, glossy color behind. This varnish, which can be used for many purposes, may be colored at will, and can also be dissolved by pouring a few drops of caustic liquid ammonia upon it, and the articles coated with it can be thus entirely freed from the varnish.

Tar Oil and Copal Varnish.

	Parts.
Light-colored copal	4
American pine resin	2
Sandarac	1
Venetian turpentine	1
Varnish oil	20

The work is done by carefully melting the copal together with the pine resin, the sandarac and turpentine are next added, and finally the varnish oil. The mass should be fluid, but no longer hot, and is first thoroughly stirred before the varnish oil is added. It is then filtered in a covered funnel through a layer of cotton.

Elastic Tar-oil Varnish.

The superiority of the following varnish consists in the fact that it is almost colorless, and when applied in a thin layer, does not show cracks, even after the lapse of considerable time. It is, therefore, especially adapted for coating finely-polished woods, and for turned articles.

	Parts.
Sandarac	6
American pine resin	2
Mastic	2
Venetian turpentine	1
Camphor	0.2
Oil of lavender	0.2
Varnish oil	24
Alcohol (90 per cent.)	4

The resins are melted together with the turpentine, the camphor and oil of lavender are dissolved in the spirit of wine, and this solution is added to the resins.

Printer's Varnish with Tar Oil.

	Parts.
Linseed oil	100
Litharge	6
American pine resin . . .	40
Tar-varnish oil	20

The litharge is boiled with the linseed oil and pine resin until the mass commences to draw threads in cooling. It is then, while still hot, mixed with the varnish oil. This varnish dries very quickly on account of the volatility of the varnish oil, and must, therefore, be kept in well-closed vessels.

Coal Asphaltum Lacquer.

When tar is distilled, there remains finally in the distilling apparatus a mass, which when cold, assumes a glossy-black appearance, and shows some of the qualities of excellent asphaltum. This tar asphaltum is particularly well adapted for the fabrication of lacquers, and in the following, we give a few directions for preparing such lacquers which may be used for various purposes. If dissolved in volatile oils and used by itself, coal-asphaltum to be sure produces lacquers of a beautiful, black color and great lustre, but they are quite brittle. This asphaltum is therefore mostly used for the fabrication of lacquers in connection with other bodies, and substances possessing the property of decreasing this brittleness are employed for this purpose. The following directions

will serve for preparing a coal-asphaltum lacquer which can be used equally well for glass, wood, leather, and metal.

100 parts of coal-tar asphaltum are melted together with 40 parts of colophony, and then mixed with 20 kilogrammes (44 lbs.) of linseed-oil varnish. When this has been intimately mixed together, 40 kilogrammes (88 lbs.) of oil of turpentine and 40 grammes (1.4 ozs.) of tar-varnish oil are added to the mass. The mixture is ready when a sample rubbed upon a glass plate solidifies to a glossy, black coating in a quarter of an hour.

If the sample should show no lustre, a few kilogrammes of tar-oil varnish are added to the mass and thoroughly mixed with it.

Tar-asphaltum Lacquer.

	Parts.
West Indian copal	30
American pine resin	30
Mineral asphaltum	30
Tar asphaltum	30
Yellow wax	6
Venetian turpentine	6

The substances are melted and made uniform by stirring. This can be recognized by the melted mass running off in a uniformly thick stream from the spatula. To the melted mass, and when it is still moderately warm,

	Parts.
Resin-oils	12
Linseed-oil varnish	30
Oil of turpentine	30
Benzole	30 to 45

are added.

But the benzole must be added at the very last, and the quantity of this depends on the object for which the lacquer is to be used. If it is desired to produce a thinly-fluid lacquer, more benzole has to be used. The more thinly fluid the lacquer is, the more beautiful and durable will it be. On account of its great lustre, this lacquer can also be used for the manufacture of the so-called Japanese wares. It will take a very beautiful gloss by repeatedly rubbing it with a flannel rag.

Double Asphaltum Lacquer.

	Parts.
Mineral asphaltum	18
Tar asphaltum	18
American pine resin	18
Linseed-oil varnish	10
Oil of turpentine	10
Light coal-tar oil	10
Benzole	20
Lampblack	2

In preparing this kind of lacquer, the following method is observed: The natural asphaltum is first melted together with the colophony, the tar asphaltum

is then added, and the other fluids are only mixed with these bodies after they have become uniformly melted. Finally the linseed-oil is added, which should be first intimately rubbed together with the lampblack.

Asphaltum Lacquer for Leather.

	Parts.
Mineral asphaltum	10
Tar asphaltum	10
American pine resin	10
Wax	2
Paraffin	3

are mixed together for preparing this very beautiful lacquer, which is also used under the name of military lacquer, for lacquering straps, cartridge-boxes, etc.

Forty parts of good linseed-oil varnish and two parts of Paris blue are added to the melted mass. The fluid is then heated under continual stirring until it commences to give off heavy vapors. From this time on, samples of it must be tested. If a cooled-off sample can be drawn out into fine threads, and leaves no fat-like edge when dropped hot upon a piece of paper, the mass is allowed to cool off as much as possible without becoming viscid, and

	Parts.
Oil of turpentine	10
Benzole	10

are added to it.

A solution of 11 parts of methyl-violet in 10 parts of strong alcohol must first be applied to the leather

to be lacquered, and when this has become dry, the lacquer is laid on. The coating of lacquer will then have a glossy, bluish black appearance.

Directions for other Volatile Varnishes.

Amber Varnish.

	Parts.
Amber	30
Venetian turpentine	5
Oil of turpentine	100

Amber and Copal Varnish.

	Parts.
Amber	10
Copal	30
Venetian turpentine	5
Oil of turpentine	80

Copal Lacquer for Mechanics.

	Parts.
East Indian copal	1
Oil of turpentine	1
Benzole	1

The benzole must only be added after the solution has been accomplished and the fluid has cooled off.

Varnishes for Making Rubber Balloons Impermeable.

These varnishes are prepared of farinaceous substances, gum tragacanth, or other vegetable gum, dextrine, sugar, albumen, collodion prepared without ether, glue (insinglass, common glue, or lip-glue).

These are freed from all undissolved substances by straining them through a hair sieve, and must be entirely clear. The main point in respect to these varnishes is that they should form an impermeable but as thin a layer as possible upon the balloon or other articles to which they may be applied. The balloon is coated with the varnish as soon as it is filled with gas, for the purpose of closing the pores of the rubber and to cover them with a film through which the hydrogen gas cannot penetrate. Water or diluted spirit of wine is used as a solvent for the substances. Fatty substances must not be employed, as they might exert a decomposing effect upon the rubber. Only the collodion is mixed with a very small quantity of castor oil, so that the film produced upon the balloon may not be too brittle.

Receipt I.

If the varnish is to be prepared of gum and sugar, the following ingredients are used:—

	Parts.
Gum	32
Sugar	8
Water	60

The proportions may be changed at will, according as it is desired to have the varnish more or less pliant. The varnish becomes harder if less sugar is used.

Receipt II.

If dextrine is used for making the varnish:—

	Parts.
Dextrine	28
Best glue	12
Water	60

are taken.

These proportions may also be varied according as the varnish is to be more or less pliant. It becomes harder the more dextrine is employed. If a very pliant varnish is desired, but not very durable, glue alone may be used, by taking 60 to 70 parts of water for each 100 parts of varnish to be prepared. In regard to the collodion varnish, this must contain from 5 to 6 per cent. of castor oil, but the collodion must be prepared without ether.

Receipt III.

The following mixture may also be used:—

White wine	700	grams.	(24.5 ozs.)
Gum tragacanth	200	"	(7 ozs.)
Treacle	150	"	(5.25 ozs.)

These substances are mixed together and boiled for thirty minutes, are then allowed to cool off, and compounded with

300 grams. (10.5 ozs.) of alcohol. This mixture is filtered and immediately filled into bottles.

Black Lacquer for Iron.

Common asphaltum is melted in a boiler, and rectified petroleum is added to it under continual stirring until a cooled-off sample shows sufficient consistency to be applied with a brush. The drying of this varnish can be much accelerated by heat, as it will bear a high degree of heat, and besides its beautiful, black color possesses the valuable quality of being elastic. For articles of iron there is no cheaper, and at the same time better protecting coat than one of asphaltum and petroleum lacquer.

Lacquer for Iron.

	Parts.
Asphaltum	20
Colophony	5
Lampblack	2
Petroleum	50

Caoutchouc Varnishes.

Caoutchouc varnishes possess the exceedingly valuable property of offering a complete resistance to the influence of water, and in this respect surpass all other varnishes. Besides, in consequence of the elasticity of the caoutchouc, articles coated with this varnish will show no cracks, even if they stand never so long. There are numerous solvents used for preparing these varnishes, but sulphide of carbon, ether, and oil of turpentine are especially used for the purpose. The oil of caoutchouc gained in the dry distillation of

caoutchouc possesses scarcely a greater solving power than the oil of turpentine, but the latter is by far the cheaper. Benzole is particularly well adapted for forming the caoutchouc solutions, and is to be preferred to the sulphide of carbon (though this is also an excellent solvent for caoutchouc), if only for the reason that the vapors of benzole do not exert such an injurious effect upon the health of the laborers as those of sulphide of carbon.

Strictly speaking, every solution of caoutchouc is already a varnish, and such solutions are particularly well adapted where a colorless coating, and one which will not crack, is desired. Copperplates and maps can be very well coated with a simple solution of caoutchouc in sulphide of carbon. The best method for preparing these varnishes is to allow the caoutchouc to swell up in the sulphide of carbon, and to effect the final solution by adding benzole and placing the vessel in warm water. The solutions should remain standing as long as possible upon the undissolved residuum to become clear. They are then carefully poured off into other bottles, and stored away until they are to be used. But the bottles must be tightly corked, as this solvent is very volatile. Varnishes containing other varnish—especially copal varnish—besides caoutchouc possess the good qualities of both varnishes, though they dry somewhat slower than the pure caoutchouc varnish. But the last-named quality may be rather called an advantage than otherwise, as solutions of caoutchouc in benzole or sulphide of carbon dry so

quickly as to require special skill to apply them in a uniform layer.

Caoutchouc Varnish.

	Parts.
Caoutchouc	1
Sulphide of carbon	10

The caoutchouc is cut up in small pieces, these are placed in a bottle and sulphide of carbon is poured over them, and the tightly closed bottle put in a warm place. The caoutchouc swells up very much, but dissolves only partly, and after standing for a long time forms a clear solution over a slimy sediment. The solution must be poured off very carefully.

Benzole dissolves caoutchouc better. Portions of it are gradually added to the caoutchouc until this is changed into a jelly. This is then reduced with light tar-oil (having a density of 0.84 to 0.85) and filtered. The most complete solution is obtained by pouring benzole over the pieces of caoutchouc which have been treated with sulphide of carbon, and mixing the solutions together.

This varnish dries with extraordinary quickness, leaving a very thin film behind, and is therefore especially suitable for coating copperplates, maps, photographs, etc. The layer of varnish has neither color nor lustre, is therefore invisible, and articles varnished with it can be cleansed with a moist sponge. If a tissue is dipped into this varnish or painted over with it, the stuff will be made water-proof, and fine cotton

or silk goods treated in this manner assume a very peculiar transparent appearance. Burns covered with this varnish cease to pain, as it excludes the air and heals very quickly.

Whenever an article is to be made water-proof in the cheapest manner, this varnish is the best means for accomplishing the object. Matches and rockets dipped several times into this varnish may lie in water for hours without losing their inflammability.

Linseed Oil and Caoutchouc Lacquer.

1 kilogramme (2.2 lbs.) of caoutchouc is swelled up with 0.5 kilogramme (1.1 lb.) of ether and made fluid by heating. It is then compounded with 1 kilogramme of warm linseed oil and 1 kilogramme of warm oil of turpentine. The fluid is then put in a bottle to clear.

Elastic Caoutchouc Varnish.

1 kilogramme (2.2 lbs.) of colophony is heated to such a point that the mass commences to throw out vapors; 500 grammes (17.5 ozs.) of caoutchouc cut into small pieces are then gradually added. The mixture must be constantly stirred, and, when it has become quite uniform, 1 kilogramme of hot linseed oil is added in portions. It is then heated until disagreeably smelling vapors commence to be developed. The vessel is then taken from the fire, and the stirring is continued until the entire mass has become cold.

The varnish obtained in this manner can be advantageously used as a perfectly water-proof coating for

leather and tissues, and such articles coated with it can be repeatedly bent without cracking the lacquer.

Only unsatisfactory results are obtained by endeavoring to dissolve caoutchouc in common petroleum; for caoutchouc is only soluble in petroleum almost free from water. It is only necessary to treat petroleum with sulphuric acid to free it from water. For this purpose, 100 parts by weight of petroleum are mixed with 10 parts by weight of concentrated sulphuric acid in a vessel provided with a stirring apparatus. When the two fluids have been again separated, the petroleum is placed in a bottle containing 1.5 kilogramme (3.3 lbs.) of litharge and 0.5 kilogramme (1.1 lb.) of pyrolusite. The bottle is then thoroughly shaken and left quietly standing to allow the fluid to become clear. Petroleum treated in this manner is an excellent solvent for caoutchouc, and should be used especially in all cases where it is desired to obtain a varnish which will dry quickly.

Hard Caoutchouc Lacquer.

Old combs of hard caoutchouc or other waste of caoutchouc can be used for preparing this excellent lacquer which may be used for all purposes. The hard caoutchouc is melted in small portions in an iron pot, but it must be constantly stirred with an iron spatula to prevent the mass from burning to the pot. When all has been melted, the fluid mass is poured out upon a tin-plate and broken into pieces after it has become cold. These pieces, resembling glossy black

pitch, are put in a bottle, and five to ten times their quantity of rectified oil of turpentine poured over them. Instead of using oil of turpentine alone, a mixture of equal parts of this and benzole may also be used, which will dissolve the caoutchouc in a short time.

When the greater part of the mass has been dissolved, it is carefully poured off from the sediment; and a dark brown lacquer is obtained which furnishes an excellent coating for metal, and, when repeatedly applied, gives it a glossy black color resembling that of the hard caoutchouc itself.

Lacquer for Leather.

	Parts.
Caoutchouc varnish	3
Volatile copal varnish	3

Lacquers for Metals.

Gold Lacquer for Metals.

A solution of white shellac in strong spirit of wine is mixed with so much of a saturated solution of picric acid as to give the desired gold color to the fluid when it is applied in a thin layer. The solution is compounded with 1 per cent. of crystallized boracic acid, which is easily dissolved.

Black Lacquer for Metals.

A tenth part of finely ground vine-black is added to the ordinary black lacquer for metals prepared with

asphaltum. The lacquer by this loses the disagreeable quality of cracking, and this can be still more completely prevented by using the lacquer very thin and repeating the application.

Hugue's Dead Lacquer.

This lacquer has no gloss after it has become dry, and is also entirely colorless. It may be prepared according to the following directions:—

	Parts.
Ether	560
Benzole	240
Sandarac	40
Canadian balsam	10

The sandarac resin is first dissolved in the ether, and then the remaining fluids are mixed with the solution, and the lacquer is cleared by being allowed to stand quietly for some time.

Dead Varnish for Metal Articles.

	Parts.
Sandarac	3
Castor-oil	1
Spirit of wine	20

Black-Tar Lacquer.

Coal-tar is heated in a boiler to such a degree as to bring it to a lively ebullition. The articles to be lacquered are also first strongly heated, then dipped into the hot tar and allowed to drain off well over the

boiler. They will then have a glossy, black appearance, and can stand a pretty high temperature without the lacquer undergoing a change.

Black Amber Lacquer for Metals.

This lacquer is prepared in the following manner: Chips of amber are melted in an iron vessel, and the same quantity by weight of the finest asphaltum in another vessel, and both resins are heated to a point where they commence to evolve heavy vapors. As soon as this takes place, boiling linseed-oil is added to each of the resins. The linseed-oil should be one-half the quantity by weight of the resins originally used. The oil is stirred thoroughly into the resins, and both fluids are then put together into one vessel. This lacquer has the valuable quality of retaining its lustre even after frequently repeated washings, and does not crack off. In lacquering articles of metal with it, it is advisable to heat them pretty strongly, and to use the lacquer also in a hot state, as it can then be applied in a very thin layer. An excellent lacquer is also obtained by using copal instead of amber, but it is less durable than the somewhat dearer amber lacquer.

Lacquer for Iron.

If it is desired to protect iron against the influence of the atmosphere in a cheap and at the same time durable manner, no simpler and cheaper means can be found than treating it with ozocerite. Ozocerite is a fossil wax found in a layer of bituminous shale, which

is brought into commerce from America as well as from Galicia and Roumania. It forms a brown resinous mass, and fuses at about 60° C. (140° F.). For the purpose of lacquering articles of iron with ozocerite, this is melted in a boiler and the melted mass is heated to the boiling point of water. The sheet-metals to be lacquered should be previously made as bright as possible by rubbing them with sand. They are then dipped into the melted mass, allowed to drain off, and then the ozocerite is set on fire by holding the metal over a coal fire. After the ozocerite has burned for some time, the flame is extinguished, and the iron appears then with a tenaciously adhering, black coating, which perfectly resists the influence of the atmosphere, and suffers no injury from acids and alkaline bodies. If the iron is to be used for vessels which are to be employed for holding alkaline fluids, it is advisable to repeat the lacquering.

Varnish for Mechanics.

	Parts.
Colophony	25
Dragon's-blood	5
Gamboge	6
Gutta-percha	10
Shellac	3
Volatile tar-oil	200

This varnish is particularly adapted for all mechani cal work which is to show bright metal, as, for instance, photographic objectives, microscopes, etc. The quan-

tity of dragon's-blood is either increased or decreased according as it is desired to have a bronze, yellow, or brass color.

Gold Lacquer for Metals.

	Parts.
Asphaltum	10
Volatile tar-oil	100

Black, Glossy Lacquer for Metals.

	Parts.
Asphaltum	50 to 60
Volatile tar-oil	100

Asphaltum dissolves very easily in volatile tar-oil, and furnishes a coating for metals which adheres very tenaciously; the first receipt is especially adapted for brass, bronze, etc., and can be made of a light golden color by suitably reducing it; the second receipt may be especially recommended to mechanics, as with it a glossy, black coating can be applied on iron in a very simple manner, a coating which can stand considerable heat without being destroyed. It is advisable to apply the varnish in a thin layer, to dry it quickly over a coal-fire and to repeat the operation till the coating is of sufficient thickness. This kind of lacquering, when rubbed, takes a very fine polish.

Wax Lacquer.

	Parts.
White wax	10
Benzole	15 to 18

16

The solution reduced with petroleum or light tar-oil is very suitable for a varnish for mechanics (for bright, especially white, metal), and furnishes a coating which is almost invisible, but which preserves perfectly the lustre of the metal and which can stand a considerable degree of heat.

XI.

FAT VARNISHES.

FAT varnishes are prepared with fat oils, and the principal among these is linseed oil. In describing the raw materials used for the fabrication of varnishes, we have already drawn attention to the fact, that linseed oil possesses the property of drying in a short time when exposed to the air in a thin layer. This property is still more increased if the linseed oil is heated for a length of time to a temperature at which decomposition takes place, or to use the practical term is "boiled." But the quickest way of changing linseed oil into varnish is by adding certain chemical products such as protoxide of lead, binoxide of manganese (pyrolusite), or borate of manganese to it while it is being boiled.

Chemical Process.

Although many eminent chemists have investigated the subject, yet, up to the present time, the process

which goes on during the boiling of the varnish has not been sufficiently explained; we are especially unable to explain the action of the compounds of lead, and still less that of such substances as borate of manganese, a body of which one part is sufficient to change two thousand parts of linseed oil into varnish.

The celebrated Dutch chemist Mulder gives the following explanation of the process by which varnish is formed. Linseed oil, like every other fat oil, is a salt-like body, and consists of a combination of oxide of glyceryle with fat acids; among these the oxide of glyceryle in the linoleic acid is of the most importance to us, as linoleic acid forms a particularly characteristic component of linseed oil. When the combination consisting of linoleic acid and oxide of glyceryle is destroyed, the linoleic acid is set free and forms a body which eagerly absorbs oxygen from the air, and this process goes on very quickly especially at an increased temperature, and the linseed oil is thereby changed into a tough, elastic body whose properties correspond to a certain degree with those of caoutchouc and is called linolin-caoutchouc. According to further investigations by Mulder, it is claimed, that the remaining part of the linoleic acid which has been set free by boiling (that is the part which is not at once changed into linolin-caoutchouc) is changed into a very peculiar acid. Mulder calls it linox acid, and it dries to a leather-like mass, while the entirely unchanged oxide of glyceryle forms, when exposed to the air, a half-solid, tough mass.

We do not intend to discuss further these purely chemical questions, but we would say a few words about the action of the chemical products used in the fabrication of varnishes. The action of protoxide of lead, binoxide of manganese, and oxide of zinc may be explained by the fact that these oxides, being stronger bases than the oxide of glyceryle, effect a separation of the latter body and then form salts (or soaps) with the acids set free.

The effect of minium (red lead), of permanganate of potash, and that of pyrolusite, may be explained by the fact, that these bodies *evolve oxygen* when boiled with the linseed oil, and, therefore, accelerate the oxidizing process, and, on the other hand, are changed into bases (protoxide of lead and binoxide of manganese), which form a combination with the fat acids.

In respect to the formation of varnish by the borate of manganese, a body which has made its way in the industry in a short time, on account of its excellent properties for forming varnish, we can give no theoretical explanation, except we would assume that at a higher temperature the linoleic acid possesses the property of driving the boracic acid out of the borate of manganese, and of forming a combination with the protoxide of manganese at the moment it is set free from the combination.

If linseed oil is heated or boiled until decomposition commences, it requires some time to obtain the oil entirely pure, as a scum is continually formed on the

surface. This consists principally of vegetable gum, albumen, and similar substances, which have not been removed in refining the oil. It must be heated until no more scum is formed, and the formation of varnish can only be proceeded with when the surface of the oil has become smooth and of a dark color. It may be recommended to subject the oil first to a simple refining process, so as to avoid the too long heating, which would otherwise be necessary for completely separating the coagulable substances of the linseed oil.

The oil to be refined is put in a large vessel, and an equal volume of caustic potash, 1 to $1\frac{1}{2}$ per cent. strong, is added to it. The oil and the caustic potash are mixed intimately together with a paddle, and allowed to stand overnight. As soon as the caustic potash, which has absorbed nearly all the albuminous substances, etc., has become completely separated from the oil, it is drawn off, and the oil is treated several times with water to remove the last traces of the caustic potash.

Oil treated in this manner—the process was originated by Wiederhold—gives, according to our experience, scarcely any scum, when it is heated, and can be quickly worked into varnish.

Another method of preparing the oil for the fabrication of varnish, is to store it as long as possible exposed to the influence of light. The large so-called carboys of green glass used for hydrochloric acid, which will hold from 50 to 60 kilogrammes (110 to 132 lbs.) of oil, are well adapted for this purpose.

The longer the oil can be stored in this manner the easier can it be changed into a varnish which will quickly dry when exposed to the air.

Linseed-oil varnish can be compounded to varnishes with the resins, especially with hard resins, such as amber, copal, mastic, which deserve to be called the most excellent of all varnishes, as such varnish, or lacquer, prepared in a suitable manner, and by using choice materials, will not only possess great lustre and hardness, but, besides, great elasticity and tenacity, the valuable quality of perfectly resisting for years the influence of air and water.

Practical Part of Varnish Boiling.

The boiling of varnish is an operation requiring the greatest attention, as not only the entire quantity of oil boiled at one time may be lost if the work is carried on carelessly, but also a very dangerous fire may be caused by the oil boiling over and taking fire.

When linseed oil is gradually heated, it first throws off water-vapors, which are succeeded by disagreeably-smelling vapors, which originate from the products of the dry distillation of the oil. This decomposition shows itself also by a phenomenon resembling that of boiling; the oil throws up bubbles and assumes a darker color. Now it is very important that the temperature should not be allowed to rise above a certain degree.

Unfortunately the workmen, as a general rule, do not use a thermometer—300° C. (572° F.) would be

about a right temperature—but depend only on practical tests; such, for instance, is the so-called feather test, which consists in a chicken-feather being dipped into the hot oil, and when this bends together and shrivels up with a gently crackling noise, the right temperature is supposed to have been reached.

As many badly smelling vapors are developed during the boiling of varnish, and these have an injurious effect upon the eyes and the mucous membrane of the nose, many manufacturers boil the varnish in the open air. We cannot approve of this method, because a sudden rain might have an injurious effect, as the raindrops falling into the hot oil are immediately changed into steam, by which the hot oil would be thrown out of the boiler, and the laborers would be in danger of receiving severe burns.

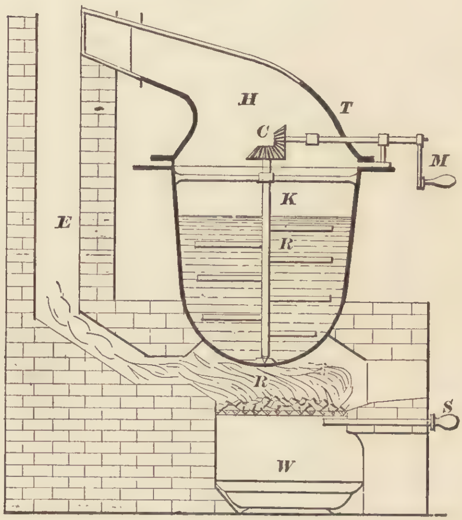
The oil should be heated only from below in such a manner that the sides of the boiler are not touched by the gases of the fire. By this arrangement an excessive heating can be far more easily avoided. Linseed oil, like all fat oils, is a bad heat-conductor; therefore, to prevent over-heating or scorching on the bottom of the boiler, the greatest care must be taken to mix, by constant stirring, the hot oil with that which is less hot.

The Boiling Apparatus.

The motion occasioned by stirring the oil, as well as the strong expansion of the oil itself when heated, demands that the vessel in which the oil is boiled should never be filled more than about three-quarters full.

The accompanying illustration, Fig. 7, represents a simple apparatus for boiling varnishes, which offers the greatest security against losses from boiling over and danger of fire, and also protects the laborers from the

Fig. 7.



effects of the noxious vapors; and, further, makes it possible to immediately extinguish the fire under the boiler in case through careless firing the temperature of the oil should rise so high that a boiling over of the oil should be feared. On account of the danger from fire connected with this work, it will be of course necessary to place this apparatus in a fire-proof room, which should be either vaulted or provided with an iron roof.

The apparatus consists of the boiler K, furnished with a stirring apparatus R, which is put in motion by the angular gearing C and the crank M. The boiler is bricked in in a fireplace; the grate R of this consists of two parts moving on pivots, which are kept in position by the rod S. In the ashpit of the fireplace is placed a tub, W, filled with water. Though only the lower part of the boiler K is bricked in in the fireplace, yet the contents of the boiler may become overheated by carelessness. If this is feared, the two parts of the grate can be dropped immediately by drawing out the rod S, the fuel drops into the tub W, and is there extinguished.

To protect the workmen as much as possible from the vapors of the hot oil, a helmet H is placed upon the flat rim of the boiler, which passes into a pipe leading into the chimney E. The vapors ascending from K pass with the gases from the fire into the open air.

Of course the capacity of the apparatus depends on the size of the factory. When large quantities are worked at one time, the heat can be easily regulated, and a large quantity of uniform varnish is obtained.

Varnishes are divided into lead, manganese, or zinc varnishes, according to the metallic compound with which they have been boiled. The quantities of these bodies to be used for changing linseed oil into varnish vary very much according to the different receipts, as much as from 1 to 50 parts by weight for every 100 parts of linseed oil.

Lead Varnishes.

Until within a very short time compounds of lead were the only known means of changing linseed oil into a quickly drying varnish,—into a siccative. Although lead varnishes possess many disadvantages, yet large quantities of them are still manufactured. We can only ascribe this to the desire to hold on to what is old, because varnishes prepared with compounds of manganese can be manufactured cheaper even than lead varnishes.

The principal disadvantage of lead varnishes is found in the fact that the dissolved compounds of lead change very easily into black sulphide of lead, which makes the varnish in time darker, and gives to the coating a dirty appearance. Should the varnish be even rubbed together with a color containing sulphur, as, for instance, yellow cadmium (jaune brillant) or cinnabar (vermillion), which is the sulphide of mercury, the color in a short time assumes a smoky appearance, and finally becomes entirely black.

For the reasons mentioned above, the preparing of lead-siccatives should be entirely done away with in the fabrication of varnishes, and this can be the easier done as no customer will especially demand a varnish prepared with compounds of lead or compounds of manganese. To the buyer it is all the same, he only demands that the varnish should dry quickly, and form a permanently light-colored layer which will resist the influence of the weather well.

Ordinary Litharge Varnish.

For preparing this varnish, the required quantity of linseed oil is brought into the varnish-boiler and heated until scum commences to form on the surface of the oil. This scum is constantly removed with a flat pan having a perforated, sieve-like bottom through which the oil taken up with the scum can run back into the boiler. When no more scum is formed and the surface of the oil has become smooth and of a dark color, the litharge is added under constant stirring. For each 100 kilogrammes (220 lbs.) of oil, from 2 to 3 kilogrammes (4.4 to 6.6 lbs.) of litharge, ground as fine as possible, are used.

Before the latter is used it should be thoroughly dried so as to be sure that it contains not even a trace of water. Should the litharge be added to the hot oil in a moist state, the latter would fly out of the boiler, in consequence of the sudden development of vapor. Litharge becomes sufficiently dry when heated for about an hour and a half at a temperature of 110° to 120° C. (230 to 248° F.), but it should then at once be added to the oil.

After the litharge has been added, the fire should be increased so as to keep the oil in constant ebullition in the meanwhile evolving vapors, and it should be kept at this temperature for about 2½ to 3 hours. The mass should be thoroughly stirred every eight or ten minutes, to prevent the heavy litharge from sinking to the bottom of the boiler. When the fluid has become

so viscid as to commence to draw threads on the stirring-paddle, the fire is increased to such a degree that the oil begins to evolve heavy vapors, and the beard of a feather quickly shrivels up when the feather-test is applied.

From this time on, the fire is no longer stirred, but care is taken to distribute the heat uniformly by diligent stirring, for this is just the point of greatest danger in regard to the running over and igniting of the oil. As soon as no more vapors are emitted, the stirring is discontinued, the fire allowed to die out, and the ready varnish is allowed to stand in the well-covered boiler until it has entirely cooled off. During this time the larger part of the undissolved litharge and a tenacious mass of oil will have settled on the bottom. This sediment is allowed to remain in the boiler and is stirred through the linseed-oil at the next boiling.

The ready varnish is lifted out with ladles and put into store-barrels to become clear. It always holds some particles in suspension, which will make it turbid, but as it cannot be passed through close filters on account of its viscid condition it must suffice to pass it through linen, which must not be too close, and which will retain the coarsest parts.

The longer the varnish is kept in the store-barrels, the brighter it will become, as all the heavy bodies suspended in it will sink to the bottom, and besides its drying power increases also as old varnish becomes dry in a few hours after it has been applied. Its power of drying is still further increased by not filling

the barrels entirely full and leaving the bung-holes open, but it is advisable to cover them loosely with paper to prevent dust from falling into the varnish.

Minium (Red-Lead) Varnish.

Lead varnish is prepared quicker and more completely by using minium or red lead, an oxide of lead containing more oxygen, than when litharge alone is employed. When minium is heated, a part of its oxygen is set free, and acts upon the linseed oil as an oxidizing agent. The product formed by oxidation then forms a combination with the oxide of lead.

One of the principal conditions for quickly changing linseed oil into varnish is, that the compounds of lead are used in as finely divided a state as possible; therefore, the greater expense of buying washed protoxides and red oxides of lead should not be regretted, as by doing so, time, labor, and fuel are saved.

Lead Varnish without Boiling.

The following proportions are used for preparing this varnish:—

	Parts.
Sugar of lead	5 to 7.5
Litharge	5
Linseed oil	100

Lead vinegar is prepared by dissolving the sugar of lead in water and treating the solution with litharge. The litharge is first rubbed together with a small part of the linseed oil, then stirred together with the rest

of the oil, and finally the lead vinegar is added. The fluids must be intimately mixed together by thorough stirring, which should be continued for at least from one and a half to two hours. We would recommend the mixing of the fluids in a barrel fastened to a turnable axle. The barrel should be about five-sixths full. When the fluids have been thoroughly mixed together, they are allowed to stand quietly until two distinctly separated layers have been formed, the lower of which consists of the solution of sugar of lead, and the upper of varnish.

Varnish obtained in this manner has a very light color, and is so thinly fluid, that it can be filtered through cotton or felt. On account of its thinly fluid condition, the lead dissolved in it can also be separated. Sulphuric acid forms insoluble sulphate of lead with every soluble compound of lead; therefore, one per cent. of sulphuric acid mixed with five parts of water is added to the varnish, and the mixture stirred for half an hour. The varnish assumes a milky appearance, but soon becomes clear, as the sulphate of lead, being very heavy, sinks quickly to the bottom.

Litharge and Minium Varnish.

A good varnish can be conveniently prepared in any large pot or boiler without the necessity of actually boiling it by mixing together the three compounds of lead used for boiling varnish. One part of litharge and one part of minium are intimately mixed together with one and a half part of sugar of lead, and one kilo-

gramme (2.2 lbs.) of this mixture is placed in a bag of close linen. A boiler or pot is then filled with 30 liters (7.92 gals.) of water and about 30 liters (7.92 gals.) of linseed oil, and the bag suspended in the oil. The mass is then heated until all the water has been evaporated, and the varnish is filtered through a felt funnel while it is still hot.

The two last mentioned methods for preparing linseed-oil varnish are especially suitable for mechanics who desire to prepare their own siccatives. Very good, quickly drying varnishes can be prepared in this manner on any common cook-stove without danger, as the oil does not require to be heated very much.

Manganese Varnishes.

Manganese varnishes are prepared with the help of protoxide, sesquioxide, binoxide (pyrolusite) of manganese, but especially with that of borate of manganese. The last-named compound particularly furnishes varnishes of such excellent qualities, that it deserves the preference above all other compounds used for the same purpose.

Borate of Manganese Varnish.

We prepare this varnish in a simple manner according to the following method: two kilogrammes (4.4 lbs.) of borate of manganese perfectly dry and *free from iron* (*i. e.*, pure white), and changed into a fine flour, are gradually stirred into 10 kilogrammes (22 lbs.) of linseed oil which have been previously heated

in a suitable vessel. The salt is uniformly divided in the fluid by constant stirring, and is heated until the oil shows a temperature of 200° C. (392° F.). As has been already mentioned, only borate of manganese entirely free from iron furnishes *quickly* drying varnish.

At the same time 1000 kilogrammes (2200 lbs.) of linseed oil are brought into the varnish-boiler and heated until it commences to throw up bubbles. The contents of the vessel in which the linseed oil together with the borate of manganese has been heated, are then allowed to run in a thin stream into the boiler, the fire is increased, and the entire mass is brought into violent ebullition. When ebullition has continued for about twenty minutes, the ladling out of the varnish is commenced, and this, while still hot, is filtered through cotton, and can be used at once. Wooden tablets dipped into the varnish while still hot will, in sixteen or eighteen hours, become covered with a perfectly dry, glass-like layer of varnish.

It was shown by special experiments which we made on this subject, that borate of manganese possesses the property of changing, even at a very low temperature, linseed oil into varnish; in fact, a temperature of 40° C. (104° F.) suffices for the purpose. If a small linen bag containing about 30 grammes (1.05 ozs.) of borate of manganese is suspended in a bottle holding about 10 liters (2.64 gals.) of linseed oil, and this bottle is put in a pot filled with water, and placed in a warm place, for instance, on the plate of a cook-

stove, the linseed oil will be changed into a quickly-drying siccative in from ten to fourteen days.

Although borate of manganese produces the best results of all compounds of manganese, yet for the sake of completeness we will describe in the following pages some methods of working with other compounds; but we remark once more, that none of them furnish better results than the borate, while the process of preparing varnish with them is more tedious and complicated than with the last-mentioned compound.

Varnish with Sesquioxide of Manganese.

1000 kilogrammes (2200 lbs.) of linseed oil are put in a boiler, and heated to a temperature of about 70° to 80° C. (158° to 176° F.); 3 kilogrammes (6.6 lbs.) of crystallized sulphate of manganese are dissolved in as little water as possible, by heating it in a special iron vessel. When it is dissolved, the vessel is lifted from the fire, and a solution of 10 kilogrammes (22 lbs.) of caustic potash, in a little water, is added, and quickly stirred through it, and the contents of the vessel are then poured into the oil. The mass, at first turbid, assumes a dark color in about half an hour, but becomes clear at the same time, as a sample taken from the boiler will prove, because the hydrate of the sesquioxide dissolves in the oil.

As soon as the oil is in this condition, a rubber pipe with a metal rose on the end of it is sunk into the boiler, and a current of air is for several hours forced through the oil by a pump. The color of the oil be-

comes constantly lighter, because the hydrate of the sesquioxide of manganese is decomposed and brown sesquioxide is precipitated.

The formation of varnish is in all cases accelerated by forcing air through the oil, as thereby a chance is offered to the oil to absorb large quantities of oxygen. Special apparatuses have been constructed for this purpose. They consist of a tall iron pipe placed above the boiler in which the oil is heated. The oil is lifted from the boiler by a pump, divided into small drops by passing through a rose, and falls down through the pipe like a shower of rain. At the same time a current of hot air is forced through the pipe in an opposite direction from that of the falling oil, therefore upwards.

This method might be especially adapted for large factories where it would be required to produce considerable quantities of varnish in a very short time. But the ordinary method answers all purposes for quantities of linseed oil up to 1000 kilogrammes (2200 lbs.), especially when borate of manganese is used.

Varnish with Pyrolusite.

Good varnish can be prepared with binoxide of manganese, found in nature as pyrolusite, by heating 100 kilogrammes (220 lbs.) of oil to a temperature of about 180° to 200° C. (356° to 392° F.), and adding a mixture of 2 kilogrammes (4.4 lbs.) of finely powdered pyrolusite and 2.5 kilogrammes (5.5 lbs.)

of sulphuric acid. This mixture, when heated, evolves oxygen, which promotes the oxidation of the oil, and at the same time dissolves the sesquioxide of manganese in the oil. When it has been heated for about one and a half hour, thick milk of lime, obtained by slacking 1 kilogramme (2.2 lbs.) of burnt lime, is added, and after this has stood for about twelve hours the varnish is filtered through a felt funnel.

Varnish with Oxide of Zinc.

Though oxide of zinc used in a pure state, when boiled with linseed oil, produces varnish, yet it dries very slowly, and has only the advantage over lead varnish of not acquiring a dark color when exposed to air containing sulphide of hydrogen, as sulphate of zinc is white. Used in combination with borate of manganese, oxide of zinc does excellent service, but we have good reason to suppose that the oxide of zinc does no work whatever, and that the borate of manganese must here also be considered as the actually effective agent.

French manufacturers advertise at a pretty high price a mass which they call "siccatif zumatique." According to their statements this mass possesses the extraordinary power of drying forty times its weight of zinc-oil paint in the course of one day. But as is well known, any tolerably good varnish dries sufficiently well in twenty-four hours to allow the coating to be touched with the hand; therefore, the so much-lauded property of "siccatif zumatique" is nothing so

very extraordinary after all. According to different analyses, the article in question consists of from 90 to 95 per cent. of borate of manganese, and 5 to 10 per cent. of oxide of zinc. As we have already seen, a considerably smaller quantity of borate of manganese is sufficient to change pure linseed oil into siccative.

Considered from a chemical standpoint the only advantage of an addition of oxide of zinc would be that the peroxide of manganese is separated from the borate of manganese by the oxide of zinc. But up to the present time it is an open question whether this is actually the case.

To judge from what we have mentioned about the nature of the different methods of preparing fat varnishes, scarcely a doubt can remain as to which of them deserves the preference. The manganese varnishes, and amongst them the varnish prepared with the borate of manganese, must be considered as the most valuable of all. A manufacturer, after once having made comparative experiments with varnishes prepared with borate of manganese and those prepared with compounds of lead, will be convinced in a short time that lead varnishes must be considered as obsolete products, not only because they always become darker, but they may even cause the coating to become entirely black, and besides, the varnishes prepared with borate of manganese have a lighter color, and dry quicker than those prepared with compounds of lead.

Frequently resins are added to the fat varnishes, or they are mixed with oil of turpentine varnishes. When the work is carried on by only adding resins to the varnishes, and generally the hardest and best resins, such as amber and copal, are only used for this purpose, the so-called fat lacquers or lac-varnishes are obtained. In the other case, mixed varnishes are obtained inferior in quality to the actual fat lac-varnishes, though it is customary to also term them fat lacquers.

Directions for Preparing Fat Lacquers.

As has already been mentioned, fat lacquers are prepared with the help of the hardest resins, *i. e.*, with copal or amber. These lacquers deserve to be regarded as the most valuable of all varnishes. The qualities in which they especially excel are a beautiful, glossy, glass-like appearance, which loses its beauty only after a long time, even if exposed to the influence of the weather; next, they possess considerable elasticity, and finally they do not crack or peel off.

There are a large number of receipts for preparing such varnishes, and such receipts are frequently offered for sale. Actually these varnishes are not more difficult to prepare than others. As in manufacturing other varnishes, the principal point of the whole work is that a complete solution of the resins in the fat oils take place, and that the resin be not merely changed to a slime-like mass.

Copal Lacquer.

Apparently the simplest method of preparing fat copal lacquer would be by intimately mixing copal dissolved in any volatile solvent with a good linseed-oil siccative, and by evaporating the solvent by heating the lacquer in a distilling apparatus. The solvent could be regained by cooling off, while the dissolved copal would remain in the fat oil. But, as is well known, such a process would require the use of thoroughly melted copal. But the cost of the latter would be considerably higher than if the work were done with the ordinary, *i. e.*, undistilled copal, as a considerable loss of volatile products is caused by dry distillation.

In practice it is, therefore, the object to at least reduce as much as possible the loss caused by distilling the copal. This may be done by heating the copal only to such a degree that it appears to be entirely melted, and by trying to unite the melted mass with the linseed oil.

Fat Copal Lacquer by Boiling

can only be obtained of faultless quality by special skill, as it is not by any means easy to hit the exact moment when the copal unites with the oil. That is to say, this union takes place only at a certain degree of heat. In the following we give directions which, if strictly observed, will always produce varnish of excellent quality. Take

	Parts.
Copal	28 to 32
Linseed oil	100
Litharge	2 to 3
Oil of turpentine . . .	70 to 80

The quantity of copal to be used determines also the quantity of oil of turpentine. A smaller quantity of the hard East Indian copal will be required, and more oil of turpentine may be added; but if soft copal is used, a larger quantity of it will be necessary, and the quantity of oil of turpentine must be decreased. In case the work has to be done with a variety of copal never before used, it will be necessary to determine the quantities by a little experiment.

The entire mass of the linseed oil is heated in a suitable boiler until the oil commences to throw up small bubbles; while keeping the oil at this temperature, the fourth part of the entire quantity of copal is melted over an open fire, in a small boiler having ears provided with wooden handles. This melting requires the greatest care and attention of the workman. The copal must be constantly stirred; should the separate pieces commence to adhere strongly to each other, the more solid pieces must be dipped under the formed fluid in such a manner as to keep all parts at as uniform a heat as possible. Finally, the resin is all melted, and, when heated further, commences to throw up bubbles and to smoke. This is the moment when the melted resin must be mixed with the hot linseed oil.

With a ladle holding about twice as much oil by weight as the quantity of copal melted at one time, the hot oil is dipped from the boiler and allowed to flow in a very fine stream through the narrow spout of the ladle into the melted copal. In the mean while the mass must be stirred very quickly and without intermission, until the contents of the boiler form a uniform, quietly flowing mass.

This small boiler is then placed alongside of the large boiler to keep it hot, and the same operation is repeated in another boiler with another fourth part of the quantity of copal. This boiler is also kept warm, and a third and fourth boiler containing the corresponding quantities of copal and oil are taken in hand. When the work with the last (fourth) boiler is finished, all the solutions of copal are added to the linseed oil still remaining in the large boiler.

The small boilers are quickly emptied in succession, and the contents of the large boiler are now continually and uniformly stirred. As a considerable quantity of viscid solution of copal remains adhering to the sides of the small boilers, this must be gained as quickly as possible. As soon as the solution has been poured into the large boiler, a ladleful of oil of turpentine is poured into the small boiler, which has been first thoroughly heated, and an attempt is made to detach as quickly as possible the solution of copal adhering to the sides of the boiler, and to mix it with the oil of turpentine. It is best to use for this purpose a supple spatula of hard wood, which may be easily

bent into a form corresponding to that of the side of the boiler. Ratan covered with rubber is also very suitable for this purpose. When the sides of the boiler have become bright, which may be easily observed by tilting the boiler a little, the four boilers are allowed to stand in a warm place until the lacquer in the large boiler is done.

The linseed oil in the boiler, now containing the entire quantity of copal to be used in solution, must now be boiled into varnish. As has been mentioned in the foregoing receipt, litharge may be used for this purpose, though we have used borate of manganese for a long time, and with the best success (0.25 part of borate of manganese is sufficient for 100 parts of linseed oil). The litharge, or borate of manganese, is allowed to fall gradually into the solution, which, in the mean while, is stirred very strongly, and the temperature is raised to the necessary degree. The scum appearing on the surface of the oil must be constantly removed.

When the fluid has been boiled for two hours, counting from the time when the litharge was added, tests are commenced to be made. When a spatula is dipped into the fluid, the lacquer should adhere to it in a thick layer, and drop from it in transparent, golden threads, becoming very thin towards the last. By the so-called drop-test a drop of the lacquer, when allowed to fall upon glass, should form a high arch, and when cold should be of the consistency of thick, thread-

drawing syrup. Firing is discontinued as soon as this phenomenon appears, and the contents of the boiler are allowed to cool off to about 60° or 70° C. (140° or 158° F.), and then the oil of turpentine contained in the four small boilers is added.

The remaining quantity of oil of turpentine must not be added in too large portions. First about 10 per cent. of the quantity of oil of turpentine is added, and later on only 5 per cent., and the fluid should be tested every time after it has been thoroughly stirred. As long as the tested fluid is yet viscid in a corresponding degree after it has become cold, and quickly becomes thick, more oil of turpentine may be added. But if it is observed that the fluid already becomes less viscid after only a small quantity of oil of turpentine has been added, it is a sure proof that the limit of adding oil of turpentine has been reached, and that the quality of the varnish would be injured by adding any more.

Well-prepared copal lacquer should be viscid, and have a light golden color, should be easy to apply and without forming streaks, and should become completely dry in from six to twelve hours.

As may be seen from the above description, this method of preparing copal lacquer is quite complicated, and requires at least two workmen, and these are sufficient only when they are very experienced, and it is, therefore, advisable to add a third workman (for stirring).

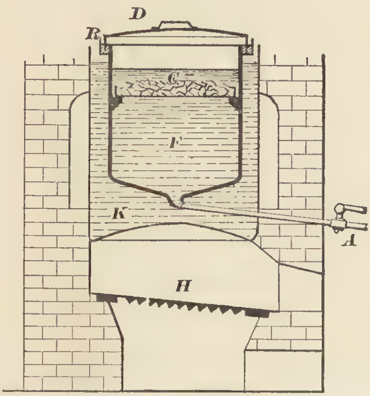
Fat Copal Lacquer without Boiling.

It has been previously mentioned that melted copal can be easier dissolved than that which has not been melted. Therefore, if distilled copal is used, a fat copal lacquer can be prepared without boiling being necessary. This is done by the use of water vapor, which is conducted in serpentine pipes through a mixture of fat and volatile oils, in which the copal is immersed.

Apparatus for Preparing Lacquer.

It is not always practicable to introduce and use steam in a varnish factory, as this would only pay

Fig. 8.



where very large quantities of varnish are manufactured. But for many purposes boiling water may be substituted for steam. Fig. 8 represents an apparatus

we use for preparing very quickly large quantities of fat copal lacquer without boiling.

A boiler *K* is bricked in in a fireplace *H*. The bottom of the boiler is bent inwards, so as to offer a larger heating surface to the flame. In this boiler is placed a second boiler *F*, the bottom of which is provided with a pipe *A*, which is closed by a cock. The boiler *F* is closed by a peculiarly shaped cover. This consists of a strip of sheet-iron bent at a right angle, which runs around the whole edge of the boiler, and forms with this a gutter *R*. The cover *D* is so shaped as to fit exactly into this gutter. If the latter is filled with linseed oil, and the cover is placed in position, the interior space of the vessel *F* is hermetically closed, but without danger from steam pressure in the interior of the vessel, because as soon as steam is developed it presses the fluid in the gutter outward and escapes.

A projecting ring is fastened in the interior of the boiler *F*, at about two-thirds of its height, upon which is placed a flat vessel *C*, the bottom of which is perforated like a sieve. This vessel serves for the reception of the copal, which must be broken into coarse pieces before being used.

For copal lacquer we use the following quantities:—

	Parts.
Copal (distilled)	100
Copal oil (volatile)	20
Oil of turpentine	300 to 350
Linseed oil	100

We commence the work by filling the boiler *K* with water, and bringing it to the boiling point. At the same time the linseed oil to be used is put into the boiler. 20 parts of the copal are brought together with 20 parts of volatile oil formed by the distillation of the copal, and the thus-formed solution is poured to the linseed oil. Then the vessel *C* is put in position and filled with the copal. Finally enough oil of turpentine is added to the entire mass to cover the copal about 1 decimeter (3.94 inches) high, and then the cover is placed in the gutter filled with linseed oil.

A sufficiently strong fire is continually kept up for three or four hours to keep the water in *K* constantly boiling. The evaporated water must be replaced from time to time. Of course by this process the contents in the vessel *F* may acquire a higher temperature than that of the boiling water, which is 100° C. (212° F.); but this heat is sufficient to dissolve the copal.

The advantages offered by this apparatus deserve special attention. Considerable fuel and labor are saved, as the stirring is entirely done away with; no oil of turpentine is lost, as the inner space of *F*, as has been mentioned above, is hermetically closed by the gutter filled with linseed oil; all danger of the hot fluids igniting, which is so great when open vessels are used, is removed, and a very light-colored and entirely clear varnish is obtained, especially when the pieces of copal are not placed immediately in the vessel *C*, but are laid upon a linen cloth spread out upon

the bottom, which will serve as a filter for the solution of copal.

When the copal has been completely dissolved—the time required for this must be learned by experience—the ready varnish is allowed to flow off by opening the cock on the discharge-pipe *A*. The rarefaction of the air caused in the vessel *F* by the varnish running off would have the effect of forcing the linseed oil contained in the gutter *R* to *F* by the pressure of the outer air. It is, therefore, necessary to remove the lid before the cock is opened.

As soon as the varnish has run off, the apparatus is again prepared, and in this manner considerable quantities of the best copal lacquer can be made in a short time with a comparatively small apparatus, as the vessel *F* can be immediately filled with linseed-oil as soon as the ready lacquer has run off without it being necessary to interrupt the firing. Even the copal is dissolved somewhat more quickly in the still warm apparatus.

Colorless Copal Lacquer.

For certain purposes, especially when the lacquer is to be applied on a colored ground, it does not matter much even if the lacquering has a somewhat yellowish shade. But if the lacquer is to be laid on a white ground, for instance, such as paper, light-colored wood, etc., a yellowish shade of the lacquer, even if ever so slight, would have a disturbing influence. And

this can scarcely be avoided if copal and manganese siccative alone are used.

We prepare an entirely colorless, fat copal lacquer in the following manner: The finely powdered copal (East Indian copal) is dried for several hours in a current of hot air—at least 120° C. (248° F.). The powder is then placed in a large glass bottle together with entirely dry powdered glass or quartz-sand, and these are mixed together by shaking the bottle. Enough chloroform or petroleum-naphtha is poured upon the mixture, while it is yet warm, to cover the powder, and the bottle well closed is allowed to stand quietly overnight. The copal coming in contact with chloroform swells up, and can be easily dissolved in other fluids.

When the copal is swollen the contents of the bottle are brought into the apparatus represented by Fig. 2 (page 88), and a suitable quantity of oil of turpentine is added to them.

At first it is only gently heated, and the apparatus is so arranged that the vapors of the chloroform, which must be condensed in the serpentine pipe, flow back into the apparatus. After the mass has been heated for about an hour at a temperature of from 60° to 70° C. (140° to 158° F.), we may be sure that the dissolving of the copal has made considerable progress, and the cooling vessel is now arranged in such a manner that the vapors of the chloroform or petroleum-naphtha condensed to a fluid may run off from the lower end of the serpentine pipe. If the temperature is not

allowed to rise higher than the boiling point of the chloroform or petroleum-naphtha, these fluids can be regained entirely pure and without loss, as the oil of turpentine is not very volatile at this temperature.

As soon as the solvent has been distilled off, the cooling vessel is again so arranged that the vapors passing over must again flow back into the apparatus, and a strong fire is kept up for about one-half to three-quarters of an hour to make the oil of turpentine boil vigorously. During this time the copal will completely dissolve in the oil of turpentine.

While the solution of copal is boiling, very light-colored varnish prepared with borate of manganese is heated to a temperature of 100° C. (212° F.) in an open boiler placed in a water-bath. As soon as the boiling of the turpentine is interrupted, the solution of copal is cooled off by drawing the fire. When it shows a temperature of from 60° to 70° C. (140° to 158° F.) we commence to lift it out with a ladle, and pour it into the boiler with the varnish, and thoroughly stir it after each ladleful has been poured in.

When finally the last portion of the solution of copal has been mixed with the varnish, heating is entirely discontinued. But the mixture is still stirred without intermission for about twenty minutes, and then the very light-colored lacquer is filled into large glass bottles, where it becomes entirely clear.

Properties of Fat-Copal Lacquer.

Coatings of this lacquer have an excellent lustre, are very transparent, and at the same time very tenacious. This lacquer is especially suited for lacquering fine white furniture which has been painted with fine oil colors, and has then been pumiced smooth. The lacquer appears upon the white ground like a coating of glass.

Photographers frequently complain that the lacquers at their disposal are not hard enough, and, moreover, possess the disadvantage that the coating of the glass plate becomes full of cracks when stored for any length of time, so that it is almost impossible to obtain clear copies from such plates. We have made special experiments in regard to this, and have found that the most beautiful results are obtained by using copal lacquer prepared according to the above-described method.

Hundreds of copies were taken from glass photographs varnished by pouring this lacquer over them, without the slightest change being observed in the layer of lacquer, even when examined with a magnifying glass. But to make the coating of lacquer as durable as this, it is absolutely necessary that the photographic plate should be entirely dry. If this is not the case, this one, like all other lacquers, will in time become blistered. The only objection which can be advanced in regard to this lacquer, as compared with other photograph lacquers which have been pre-

pared with volatile solvents, is, that it requires quite a long time before it becomes completely dry. The time required is about twenty-four hours, while the volatile lacquers dry in a few minutes. This, to be sure, is a disadvantage which cannot be denied, but it is very small indeed, when compared with the advantages offered by the other good qualities of this lacquer.

Fat-Amber Lacquers.

These are prepared in the main in the same manner as the copal lacquers. Distilled amber may be used directly with linseed oil, but this produces darker-colored varnishes than when a solution of the resin is first prepared and this is mixed with a good siccative. The properties of fat-amber lacquers are nearly the same as those of the copal lacquers, but they are not as elastic as the latter. No better lacquer than good, fat-amber lacquer can be chosen for a surface requiring a very durable, glossy coat of lacquer without much elasticity. But copal lacquer is to be preferred where the latter property is required.

Fat lacquers can also be colored, and this is done in a manner similar to that mentioned in treating of volatile lacquers; but they are not very frequently colored, as complete transparency is one of the principal qualities desired in this lacquer. Usually the article to be lacquered is first painted the required color, and the layer of lacquer is applied on the coat of paint.

Other Fat Lacquers.

Manganese and Zinc Siccative.

The siccative proposed under this name contains oxide of zinc, and protoxide of manganese, and it is claimed possesses the quality of protecting coats of white paint from becoming darker, but this appears to us very doubtful. This siccative is prepared by mixing 1 part of sulphate of manganese with 2 parts of acetate of manganese and 97 parts of carbonate of zinc, and by adding 4 parts of this mixture to 100 parts of linseed oil, which has been previously heated to a temperature of 200° C. (392° F.), and it is claimed that the varnish is ready when the heating has been continued for from five to ten hours. It is evident that the protoxide of manganese, present in this varnish, is the only cause of its drying, and it appears to us that it is far more suitable to use borate of manganese.

Pflug's so-called Platina Paints.

These paints, on account of their great power of resistance, have been especially recommended for coating objects exposed to the influence of the weather. According to many analyses, they are nothing but ordinary linseed-oil varnishes, containing zinc-white, iron-ochre, or zinc-dust, according to the color required. As the composition shows, these paints differ in nothing from the cheap paints commonly used. The

praise bestowed upon the platina paints as being especially durable seems, therefore, to be nothing but a business claim.

Black Paint for School-Slates.

	Parts.
Shellac	8
Paris black	8
Paris blue	0.5
Burnt umber	4
Siccative	10
Spirit of wine	70

The shellac is dissolved in the spirit of wine, the other substances are thoroughly mixed together, and quickly rubbed together with the solution of shellac.

XII.

PRINTER'S VARNISHES.

The fabrication of printer's ink goes hand in hand with that of varnish, and deserves to be urgently recommended to the manufacturer of the latter article, on account of the large returns which a good article of printer's ink yields. In many factories the fabrication of printer's ink is treated as if it were a secret, but it is not that by any means. But many manufacturers have a certain skill in carrying out the details of the work, which exerts a considerable influence upon the quality of the product.

Good printer's ink should possess the following properties: It should show a glossy, black color, and consist of an absolutely uniform mass. The presence of the smallest solid body in printer's ink, even if it is only a minute lump of lampblack, is sufficient to cause a stain in printing. Further, printer's ink should possess the property of remaining unchanged for a considerable time when exposed to the air—but must also become completely dry in a short time after it is imprinted upon paper. Finally, it must penetrate only to a certain depth into the paper without soaking through, or it would be impossible to print the paper upon both sides so that it could be read. As will be seen from the foregoing, these are qualities which it is not easy to combine, and for this reason the manufacture of actually good printer's ink belongs to the most subtile labors of the manufacturer of varnishes.

It is very difficult to state exactly of what printer's ink consists. Linseed oil is the principal ingredient used. This is partly changed into resin, and partly decomposed by heating it in a suitable manner, and thus a particular kind of varnish is formed. Besides this, soap, resins, and various kinds of coloring matter are used, and the process is a different one when simply black printing-ink or printing-color is to be prepared. When printing-ink alone is to be manufactured, no attention need be paid to the color of the varnish which forms the basis of the mass, but this must be done when printing-colors, especially the lighter shades, are to be prepared.

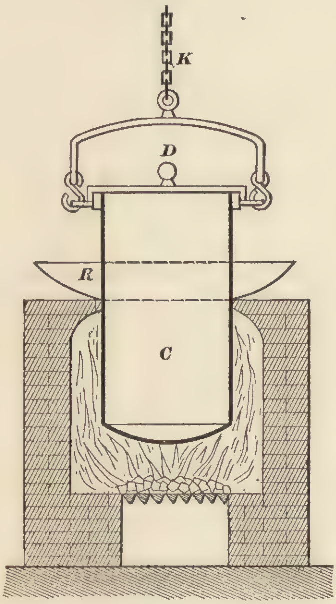
The work commences with refining the linseed oil. A fine quality of linseed oil should always be chosen for preparing printer's ink, as when an ordinary quality of oil is used a disagreeable odor will adhere to the ink, and it will have an ugly brownish shade of color. The oil is mixed with a small percentage of concentrated sulphuric acid, and heated for a few hours. In doing this, care must be taken not to allow the temperature to rise above 100° C. (212° F.). After the oil has been heated it is allowed to rest, and is then drawn off from the sulphuric acid, and repeatedly washed with warm water until every trace of sulphuric acid has been removed. If the oil has been treated in the right manner, it should have a light yellow color, and be entirely free from smell. It must be protected from the air until it is used, as it will dry very quickly when it is in this condition.

The refined oil must then be boiled. The so-called boiling consists in heating the oil to such a degree that a part of it becomes decomposed. But especially constructed vessels must be used for this purpose, as the volume of the oil increases in an extraordinary degree in consequence of the many bubbles which are formed. The most suitable apparatus used for this purpose is represented by Fig. 9.

It consists of a cylinder of sheet-copper. A ring or rim bent upwards like a shell is placed about half way up on the sides of the cylinder. The top of the cylinder is surrounded by a strong iron ring, on which

are fastened the chains of a tackle, which enables the attendants to lift the cylinder quickly from the fireplace. A helmet or cover of sheet-iron, which ought

Fig. 9.



to fit as air-tight as possible upon the cylinder, completes the apparatus, and this should be placed in a fire-proof vault so as to prevent all danger from fire. A hole connected with a well-drawing chimney should be left in the top of the vault to carry off the vapors arising from the boiling linseed oil, as they are inju-

rious to the eyes and respiratory organs. The workman who is appointed to watch the progress of the work should be provided with a stool high enough to enable him conveniently to take samples out of the cylinder. The chains of the tackle should be fastened to a movable crane, so that at the word of command an assistant can lift the cylinder immediately from the fireplace and move it aside. The cylinder is filled only half full with oil, and a strong fire is kept under it at the commencement of the work. The oil will soon commence to bubble, making a crackling noise. This bubbling is caused by the escape of water vapors which are developed from the oil and originate from water mixed mechanically with it. The bubbling entirely ceases in a short time, and as the temperature rises the oil, which now has become entirely black, swims quietly and uniformly in the cylinder.

From this moment on the oil rises constantly in the cylinder, and throws small bubbles on those places where it comes in contact with the sides of the cylinder. As soon as vapors of a pungent odor commence to rise from the oil, which always accompany its decomposition, the attendant must continually pay the strictest attention to the oil. The moment the entire mass of the oil commences to bubble up, and vapors are also developed from the interior, the fire must be quickly moderated at once, or else the fluid will surely boil over, even if the most capacious vessel should be used. If the oil should continue to rise notwithstanding the fire having been moderated, the cylinder must

at once be lifted from the hearth, and must only be replaced when the oil has subsided. But if the oil should flow over nevertheless, the overflow will be collected in the rim, and is poured back into the cylinder.

If the work is done carelessly—especially when the oil is heated too quickly—the oil flows over incessantly, ignites in most cases, and burns with a bright flame, depositing large quantities of soot. Should this take place, the lid should first be thrown upon the cylinder, and this lifted from the hearth as quickly as possible. As long as the workmen have not sufficient experience, it is advisable to put only two-thirds of the quantity of oil to be boiled into the cylinder at one time, and to cool the fluid off by pouring cold oil into it in case it threatens to overflow.

The best plan is to keep the oil at such a temperature that the developed vapors will commence to burn when a lighted candle is held near them, and continue to burn as long as they are in contact with the flame itself, but will go out as soon as the flame is removed, or that they can be at least easily extinguished by placing the lid upon the cylinder. The firing is then regulated in such a manner that the vapors will be developed quietly and uniformly, without a further rising of the contents of the cylinder, and the condition of the oil is tested by the so-called thread-test.

To make this test, a small quantity of the oil is lifted from the cylinder by a wooden spatula. This is cooled off by swinging it to and fro, and a drop of the

mass is then squeezed between the fingers and drawn out. In doing this viscid threads should be formed from one finger to the other, and these should reach a length of 4 to 5 centimeters (1.56 to 1.95 inch) before they break. If the threads break sooner the boiling must be continued. If the sample is of the required quality, the cylinder is at once lifted from the fire, and the varnish is allowed to cool off, or it is subjected to the so-called burning. This consists in igniting the vapors and allowing the mass to burn for about five minutes. The fire is then extinguished by placing the lid upon the cylinder.

In many factories it is customary to burn the varnish, and many manufacturers consider this burning absolutely necessary to obtain a good article. But the author of this work, having made many experiments on this subject, is fully convinced that the burning—no matter for what purpose the varnish is to be used—is a very unsuitable process. The most excellent varnish is obtained by continuing the boiling of the linseed oil for a sufficiently long time ; the burning of the varnish causes considerable loss.

Burning the varnish makes it very dark. This, of course, is of no consequence when it is to be used for preparing printer's ink, but the case is quite different if red, blue, green, or any printing-colors of a delicate shade are to be prepared with such varnishes. For printing-colors of delicate shades of color, burned varnishes cannot be at all used.

The consistency of printer's varnishes differs ac-

cording to the purposes for which they are to be used; the more elegant the printing is to be, the more the varnish must be boiled down, and the greater will be the expense of producing such an article. For newspapers, and generally for printing which must be done quickly, a more fluid varnish is used than for printing books. The thickest varnish is used for copperplate and lithograph printing.

Hemp oil, which is much cheaper than linseed oil, is sometimes used instead of the latter. Though it produces a pretty good color, yet the disagreeable smell of the oil adheres to it, and for this reason varnish prepared with this oil should never be used for the finer colors.

Sometimes resin is added to the varnish, so that it will not be required to be boiled down so much. It is best to use the ordinary, pure, brown pine resin for varnish which is to be used for preparing printing-ink, but it is more suitable to use the light-colored American resin if it is to be used for printing-colors. The resin should be refined by melting and filtering it before it is used, to prevent pebbles or plant-parts, which are frequently mixed with the resin, from reaching the varnish. The resin is added to the oil when the latter has been heated so far that its boiling is plainly noticeable on the edge of the cylinder. For 120 parts of linseed oil 40 to 50 parts of resin and also 12 to 14 parts of soap are used. The purpose in adding soap to printer's ink is to facilitate the cleansing of the forms which have been used. The form can be simply

washed off with a brush. The principal quality for the soap to be used is that it must be entirely dry. For this purpose it is cut up into thin shavings, and these are thoroughly dried. Yellow rosin soap answers for ordinary printing-ink, but white tallow soap must be used for fine colors.

Many manufacturers add, to the linseed oil which is to be worked into printer's varnish, a certain quantity of very finely ground indigo, which gives a beautiful tone to the color. But it is more suitable, and at the same time cheaper, to add about 1 per cent. of the finest Paris blue. This dissolves entirely in the oil when the latter has been boiled for some time, and partly imparts to it the qualities of the so-called blue lacquer.

Appendix.

Printer's varnishes are generally not sold as such, but are at once changed into printing-ink or printing-colors by the manufacturer. Lampblack prepared in special apparatuses is generally used for printing-ink. The various mineral and lac colors are used for printing-colors.

All substances used for coloring the varnishes must be rubbed very fine, and the coloring matter must be mixed with the varnish in the most careful manner, so as to obtain an absolutely uniform color. As our work is exclusively devoted to the fabrication of varnishes and lacquers, we can occupy ourselves with the subject only so far as it relates to the fabrication of

printer's varnishes, but would refer our readers who take an interest in the subject to the excellent work: "Die Fabrikation der Mineral und Lack Farben, von Dr. Josef Bersch," in A. Hartleben's Verlag, Wien, 1878 (The Fabrication of Mineral and Lac Colors, by Dr. Joseph Bersch, published by A. Hartleben, Vienna, 1878), which contains a thorough description of the processes for preparing lampblack and printing-colors.

XIII.

SOAP LACQUERS.

Soap lacquer possesses several properties which make it very valuable for certain purposes. This lacquer, which can be prepared very cheaply, possesses especially two qualities deserving to be particularly mentioned, namely, that it remains entirely unchanged in water, and has a considerable degree of elasticity. The following is the simplest method of preparing it: Good tallow soap is boiled in rain-water so that a clear solution is formed, and this is filtered through several close cloths while it is still hot. The solution is heated again and diluted with an equal volume of rain-water. Then a boiling-hot solution of alum is added to it as long as a precipitate of sebate of aluminium is formed. This precipitate is allowed to settle, the fluid standing over it is poured off, and the precipitate washed several times with boiling water.

The precipitate is then dried and heated in a pot standing in a vessel filled with boiling water, until it becomes transparent. Oil of turpentine is then heated in a pot nearly to the boiling point, and a sufficient quantity of the aluminium soap is added to form a solution of the consistency of thick varnish. Should this prove too viscid when it has become cold, it can be easily reduced by adding hot oil of turpentine.

Articles which have been coated with this lacquer should be placed near a hot stove so that they will dry quickly. Coatings of this soap lacquer do not show a great deal of lustre, but, as has before been said, are very durable and besides are cheap.

Johnson's Varnish for Preparing Water-proof Paper and Water-proof Tissues.

Green vitriol is dissolved in water, a solution of soap is added to this, and the precipitate of iron soap which is formed is collected. When this precipitate has become dry and is then dissolved in sulphide of carbon, or in benzole, a fluid is obtained which leaves behind a water-proof layer upon paper or tissues. If the paper or tissue is to remain white, a solution of alum is used instead of that of green vitriol, and a white aluminium soap is then obtained, which is used in the same manner.

Coatings with Water-glass.

Such coats adhere to walls in an actually durable manner only when the paints to be applied with the

assistance of water-glass are first mixed with a little water to a perfectly uniform dough, and this is mixed in small portions with the water-glass. Only so much paint should be prepared at one time as can be used up in about one hour, as the solution of water-glass easily coagulates, and it is then no longer possible to apply the paint uniformly.

XIV.

FITTING UP A VARNISH FACTORY.

Only a few general remarks can be made relative to the fitting up of a varnish factory, as this will principally depend on its size and capacity. It is still customary with many mechanics themselves to prepare the varnishes and lacquers they use ; cabinet-makers, turners, painters, etc., belong to this class. In this respect it is scarcely possible to speak of a factory. The entire outfit in such cases consists, as a general rule, of a room with a cook-stove, a few pots and glass-bottles. It need only here be said that the work room should, if possible, be fireproof, and should not, on account of danger from fire, be used at the same time as a store-room for inflammable fluids and varnish.

Two points must especially be kept in view in fitting up a varnish factory where work is to be carried on on an extensive scale, namely, to obtain as much

security against fire as possible, and to carry off the bad-smelling vapors. Therefore, care should be had to place the apparatuses used for boiling the varnish in fire-proof rooms. They should be vaulted if possible, or at least have iron roofs, and wooden floors should be avoided. The best plan for carrying off the bad-smelling vapors, which are especially developed in boiling linseed-oil varnish, is by conducting them immediately into the chimney, which should be of a considerable height so as not to molest the neighbors.

But, if it can be so arranged, the most suitable way is to conduct the vapors under the grate of a furnace so that they may be entirely burned. But this can only be done in case the work is carried on with an entirely closed apparatus, and this is inconvenient, as it is very difficult to observe the condition of the fluids contained in the apparatus, as even panes of glass set in the upper part of it do not allow of a close observation, and besides it must be opened from time to time to take out samples for testing the fluid.

Fabrication of Varnish by Steam.

In a large factory it is advisable to work by steam, as by so doing not only the greatest security against fire is obtained, but the work can be done more quickly, and the greatest economy in the use of fuel is possible.

A steam-boiler of suitable size is placed in a special room entirely separated from the actual working-room. It is advisable to place it in a cellar under the factory, and thus complete security against all danger from

fire may be obtained, as there will be no fire in the working-room proper. The tension of the steam in the boiler need be but very moderate—about 2 to 2½ atmospheres will be sufficient. The boiler has two pipes, one for furnishing steam of a temperature somewhat higher than that of water boiling in open vessels, and the other to conduct steam to the superheating serpentine pipe of which we shall shortly speak.

The apparatuses in which the resins are to be dissolved, the volatile solvents to be distilled off, etc., must be so arranged that the steam can give off its heat. This is obtained by placing in the vessels serpentine pipes through which the steam passes, and these must be sufficiently inclined to allow the water formed by the condensing of the steam to flow off. Larger apparatuses are sometimes made with double sides, and the steam passes through the open space between the two sides.

The form of the vessels is generally that of upright cylinders, and they are provided externally with wooden jackets to prevent them from being cooled off by the air.

According to special experiments we have made on this subject, linseed oil can be changed into the best siccative by heating it together with borate of manganese for several days at a temperature somewhat higher than 100° C. (212° F.), which can be easily reached with ordinary steam. But, of course, this method cannot readily be employed on a large scale on account

of the comparatively long time required for heating the oil.

The Superheating Apparatus.

To obtain in a few hours a quickly drying varnish from linseed oil it is necessary to raise the temperature of the oil to the point where decomposition commences. But to obtain such a temperature by the use of steam, apparatuses of extraordinary strength would be required, as the tension of the steam, as is well known, quickly increases with an increase of temperature. But there is a simple method by which water vapor can be heated to a temperature of above 300° C. (572° F.) without it being necessary to use vessels of more than ordinary strength.

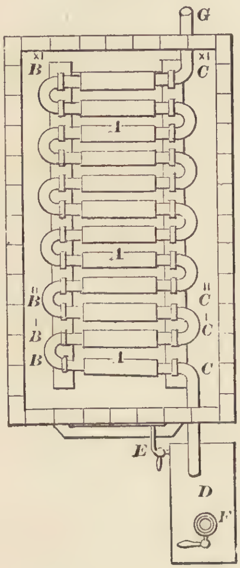
To attain this object—"to superheat" the water vapor—the simple apparatus shown in Fig. 10 is used.

The cast-iron pipes *A*, *A*, rest upon two benches built of brick in a furnace furnishing a very hot flame. The pipes are connected with each other by curved tubes of copper, *B* and *C*. These curved tubes have been tightly driven into the pipes *A* without any other connection, and rest upon the benches in such a manner that the fire cannot directly strike them.

The steam passes from the steam boiler *D F E* at a temperature corresponding to the pressure prevailing in the boiler, into the pipe system *A*, *A*, which is kept at a red heat by the fire burning under it, and passes out of the pipes at *G*, having a temperature which may be above 400° C. (752° F.). It is a very good

plan to build the superheating furnace large enough to be able to add a few pipes in case the steam should not be hot enough. If fewer pipes are sufficient, the spare room of the fire-box can be bricked up.

Fig. 10.



It is not absolutely necessary to work with steam in a varnish factory; hot air answers the same purpose. If it is desirable to work in this manner an uninterrupted stream of air is driven into the pipe system of the superheating apparatus by a centrifugal fan, and the air is conducted back to the fan after it has left

the greater part of its heat in the boiling apparatus, so that it may be said the work is actually done with the same quantity of air, which constantly makes a circuit between the superheating apparatus and the vessel in which the varnish is boiled.

It is self-evident that no lead pipes, but only iron or copper pipes, can be used in apparatuses in which superheated steam or superheated air is employed. Copper pipes, though much dearer than iron pipes, deserve the preference, as they do not produce dark-colored varnishes, though they may be somewhat affected by the hot oil.

Though it is very expensive, yet it is advisable to silver the metallic surfaces with which the varnish comes in contact. The coating need only be very thin, and can be preserved uninjured for years if the apparatuses are carefully treated, as they are not subjected to any friction. But as the bottom of the vessel suffers from friction by the stirring apparatus with which the powdered resins must be kept in motion, it is advisable to have these parts constructed of enamelled iron.

The above description gives a general idea of the rational arrangement of a factory. The details will depend on the room at disposal, and the size of the factory itself.

FABRICATION OF SEALING-WAX.

SEALING-WAX is said to be an East Indian invention which first became known in Europe in the middle ages. It seems that its use was first introduced in Spain, and from there spread over the rest of Europe, at least the respective names given to it would indicate this. The French word for it is "circe d'Espagne," and the Italian "cera di Spagna" (Spanish wax). The English word "sealing-wax" is synonymous with the German word "Siegelwachs," and it originated very likely from the fact, that, before the present composition of sealing-wax was known, colored wax was generally used for sealing letters, as is yet done at the present day for stamping seals upon deeds and public documents.

Sealing-wax, in general, consists of a mixture of resins to which turpentine, essential oil, and fragrant balsams are added, partly for the purpose of diminishing the natural brittleness of the resins as well as to facilitate their melting by heat, and partly to impart to them a sweet odor; besides various coloring substances are mixed with them.

Good sealing-wax should be smooth, glossy, and not brittle; it must bear the highest summer temperature

without becoming soft, and when burnt must melt easily without evolving smoke or a disagreeable odor, but at the same time must not become so thinly fluid as to drop. The seal made with the wax should have the same appearance as the unmelted sealing-wax, *i.e.*, it must neither change its color nor lose its lustre. The fracture of good sealing-wax should be smooth, not too lustreless, and especially must not have an earthy appearance.

The fabrication of sealing-wax can be very conveniently combined with the manufacture of varnish, as the resins also play the principal role in this branch of the industry, indeed, are even of greater importance than in the fabrication of varnishes themselves, as the principal materials for sealing-wax are nothing else but resin.

I.

MATERIALS USED FOR THE FABRICATION OF SEALING-WAX.

A LARGE part of the materials used for sealing-wax have already been mentioned in treating of the substances used for the fabrication of varnishes, and as far as these are concerned, we would refer the reader to Sections IV., V., and VI. of the first part of this work.

The principal materials used for sealing-wax are

shellac and turpentine. But besides these, several other kinds of resins are used, such as mastic, sandarac, and benzoin for the finer qualities; colophony and pitch. Fragrant balsams, balsam of tolu, balsam of Peru, as well as sweet-scented oils, such as oil of lavender, oil of mace, oil of cloves, etc., are added to hide the disagreeable odor of the burning resin.

But the coloring substances are of great importance as well as those which we will call indifferent substances, which only serve the purpose of augmenting the entire mass without exerting any influence upon the composition. Such substances, which must generally be of a white color, are, for instance, chalk, gypsum, zinc-white, and carbonate of magnesia. Sometimes brick-dust is used as an indifferent substance for common qualities of sealing-wax.

Of the Principal Materials.

It is absolutely necessary, that the shellac to be used for the finer qualities of sealing-wax should be bleached, as the reddish-brown coloring matter adhering to the natural shellac, would exert a disturbing influence, especially upon light and delicate colors which are most popular in the more expensive varieties of sealing-wax. Unbleached shellac can only be used for dark-colored sealing-wax, brown to black, as the color of the shellac will be covered by the dark coloring substances which will have to be added. It is always advisable for the manufacturer of sealing-wax, who buys large quantities of shellac, to bleach it

himself. If it is desirable to exercise particular economy, a light-colored variety of shellac may be used for light colored but not such fine qualities of sealing-wax, instead of bleached shellac, but the colors will be less beautiful.

Turpentine is the next principal material which is used, and Venetian turpentine is to be preferred to any other kind. But colophony and oil of turpentine may be used as very suitable substitutes for turpentine, and this besides offers the great advantage that it is always in one's power to regulate at will the fluidity of the mass by adding a larger or smaller quantity of oil of turpentine.

As most commercial turpentine is contaminated by splinters of wood, leaves, etc., it cannot be used immediately, but it becomes necessary to filter it for the purpose of freeing it from these admixtures. This is a tedious labor on account of the viscid condition of the turpentine, but it can be accomplished in the quickest way by heating the turpentine in a vessel filled with water heated to a temperature of 100° C. (212° F.), and filtering it through a linen cloth.

Resins, such as mastic and elemi, are only added in small quantities and for the finer qualities of sealing-wax to the actual base of the sealing-wax, which is composed of shellac and turpentine, or of shellac, colophony, and oil of turpentine. Benzoin, balsam of Peru, and the other essential oils, are only used for the perfumed varieties. In respect to the last-named substances, we would recommend that they be pro-

cured from firms of good standing, and that rather a higher price should be paid for them than might be asked for them in another store, as just such articles as balsam of Peru and essential oils are found, only too frequently, badly adulterated, and sometimes contain but a small percentage of the substances whose names they bear.

Of the Pigments which are used in the Fabrication of Sealing-Wax.

The number of coloring substances used is a very large one, as there is at present a demand for sealing-wax of all kinds of colors, and it is brought into the market in all possible shades. The best plan for the manufacturer is not himself to prepare the pigments he needs, but to buy them. It may be only recommended to prepare some few colors for which an extraordinarily high price is asked in the stores.

Red Pigments.

Of all the colors employed, red is the one of which the largest quantities are used. We know a considerable number of red coloring substances which may be used for coloring sealing-wax. In regard to the price, it is, of couse, necessary to use cheap coloring substances for cheap kinds of sealing-wax, but to be sure, they never give such a beautiful appearance to the article as the finer ones. For instance, the beautiful scarlet color of fine red sealing-wax, can only be pro-

duced with the aid of cinnabar; but not with minium (red-lead), colcothar, etc.

Cinnabar

is now always prepared in an artificial manner, namely, by heating mercury with sulphur. Cinnabar is sulphate of mercury. This expensive coloring substance is but seldom adulterated, as a very slight addition of other red coloring substances injures the fiery appearance of cinnabar, on which depends its commercial value. The purity of cinnibar can be easily ascertained by heating a small quantity of it red hot. If the cinnabar is pure, it will volatilize without leaving a residuum.

In consequence of its great weight, cinnabar would make the sealing-wax too heavy, and it is, therefore, necessary to add a certain quantity of an indifferent substance to the sealing-wax to be colored with this coloring substance, which will make it less dense.

Minium.

The commercial minium has several shades of color, according to the degree of heat at which it is prepared. The color varies from a shade inclined towards orange, to a beautiful scarlet. The tint of some kinds of minium can be considerably improved by heating them carefully upon bright sheet-iron, but the temperature must not be allowed to rise too high, as this would discolor the minium.

Colcothar (Indian-Red).

Under this name, but also under that of *caput mortuum*, a reddish-brown coloring matter is brought into the market, which consists of sesquioxide of iron, and can be bought at a very low price. Good colcothar produces sealing-wax of a very nice color. The most beautiful kind of this coloring matter is obtained in the following manner: Green vitriol is dissolved in rain water, the solution is filtered, and to this a solution of binoxalate of potassa, also prepared with rain water and filtered, is added as long as a precipitate is formed. After a few hours, the fluid standing over the precipitate is poured off, the latter is stirred up with some rain water, and is again allowed to settle. This is repeated several times, the precipitate is then collected upon a cloth, and dried in a place where it is protected from dust. The yellowish-green mass which has been collected upon the cloth, is rubbed very fine and heated in a porcelain dish under constant stirring. When a certain degree of heat has been reached, it catches fire and gradually subsides into a very fine powder of a fiery, but pleasant reddish-brown color.

Bole

is a clay colored red by being mixed with more or less sesquioxide of iron; a darker coloring can be imparted to it by mixing it with red chalk, but this, as well as the commercial colcothar, is a pigment which can only be used for common kinds of sealing-wax.

Carmine

is such an expensive pigment, that it is scarcely possible to use it even for the finest qualities of sealing-wax, though directions are given in many books how to prepare sealing-wax of a bright red color with the help of carmine.

Vienna Lake and Madder Lake

are combinations of different red coloring substances with alumina, protoxide of lead, and oxide of zinc. At the present time these lakes are prepared of an excellent quality, and in all shades of color. The manufacturer of sealing-wax should always choose the most fiery article, and most thoroughly saturated with color he can find.

Yellow Pigments.

Yellow sealing-wax is frequently demanded as an article of luxury, and yellow pigments are also frequently used for various mixed colors, or for preparing sealing-wax which shall show different gradations of color.

Chrome Yellow.

This is without doubt the most beautiful of all yellow pigments, and can be easily made by dissolving sugar of lead in rain-water, and adding to this a solution of bichromate of potassa as long as a precipitate is formed. This precipitate is washed, dried, and then

forms a bright yellow powder consisting of chromate of lead, and in commerce is called chrome-yellow. On account of its sombre color and great weight chrome-yellow is generally not used in a pure state, but is mixed with chalk, magnesia, or some other white substance.

Mineral Yellow or Cassel Yellow

is a beautiful yellow color produced by carefully fusing litharge, and by grinding and washing the powdered mass. It is also remarkable on account of its great weight.

Ochre

is a yellow or yellowish-brown earth, and can only be used for ordinary kinds of sealing-wax, as it does not possess a warm tint of color, and besides has the disagreeable property of giving an earthy smell to the sealing-wax, even if it is added in very small quantities.

Green Pigments.

For coloring sealing-wax green, it is always best to use a mixture of a yellow and a blue pigment, or the green ultramarine. To be sure there are very beautiful green pigments, such as the genuine green cinnabar and chrome-green, but they are entirely too expensive for use in the fabrication of sealing-wax, and besides their use is not to be recommended, as the same shades of color possessed by these expensive

pigments can be produced by a suitable mixing of yellow and blue.

Blue Pigments.

Ultramarine and mountain blue are used for the lighter shades, and Berlin blue for the darker shades. As ultramarine is very inexpensive, it may be used even for very cheap kinds of sealing-wax.

Brown Pigments.

Several earthy substances known as umber sienna, burnt sienna, Cassel brown, etc., are used for producing beautiful brown colors. Burnt sienna especially possesses a very beautiful warm tone of color, and for this reason is to be preferred to other brown pigments, and also on account of it being a very productive and very cheap pigment.

Black Pigments.

Finely divided carbon which according to its origin is called soot, lampblack, ivory-black, vine-black, etc., is alone used for giving a black color to sealing-wax. Frequently, these different kinds of black pigment can only be bought at very high prices; but it is not at all necessary to use them for the fabrication of sealing-wax, as common soot, if well prepared, answers for all our purposes.

The commercial soot has frequently a brownish shade of color which is produced by adhering products of tar, and a disagreeable smell which is especially ob-

servable in burning sealing-wax prepared with common soot. Soot can be prepared in a simple manner by carefully calcining it. This will remove the disagreeable smell, and at the same time a pure black color will be obtained.

Generally, a stove-pipe about 50 centimeters (19.7 inches) long, and closed on both ends by well-fitting covers, is used for this purpose. The pipe is filled with the soot to be calcined, in such a manner that it, being gently pressed into the pipe, comes up to about 4 to 5 centimeters (1.6 to 1.9 inches) below the upper rim. The upper lid, through which a hole of about the thickness of a straw has been made, is then placed tightly upon the pipe, and all the joints are smeared over with clay. It is also advisable to cover the entire pipe with clay to prevent it from being burnt through.

The pipes filled with soot are then placed in an air-furnace in such a manner that the perforated cover is uppermost, and brought to a red heat. When the attendant is convinced that the entire mass of soot is thoroughly calcined, the fire is extinguished, and after twenty-four hours, the pipes are opened—or, at least, not before the entire contents have become cold. The bad-smelling tar products which give a brownish color to the soot have been destroyed, and the latter is now entirely odorless and of a velvet-like black color.

Vine-Black or Frankfort Black

is a beautiful, black pigment, which can be prepared at a nominal cost in wine-growing countries. The same kind of sheet-iron pipes mentioned above are used for preparing it. The pipes are filled with pieces of vine-shoots, and heated as long as gases escape from the hole in the upper lid, but the hole should be made somewhat larger than for soot. The carbonized residuum remaining in the pipes is put into a vessel filled with water which has to be changed several times, for the purpose of dissolving the alkalies. To the last water but one, a quantity of hydrochloric acid equal to one-fourth of the volume of water is added to dissolve the last traces of alkaline substances. The residuum, when rubbed fine and washed, is the finest vine-black.

White Pigments.

White substances are added to sealing-wax for three reasons, namely, first, to decrease the weight of the wax which has been colored with very heavy pigments such as cinnabar and chrome-yellow, and at the same time to increase the bulk of the sealing-wax; secondly, to obtain lighter-colored masses of sealing-wax; and thirdly, to impart an actually white color to it.

In the first two mentioned cases it does not matter much what the nature of the substance is which is added to the mass of the sealing-wax, provided it is of a pure white color and of but little weight. But in the last

case where the white substance is also to serve as the actual coloring matter, its nature must be taken into especial consideration, and only such coloring substances should be chosen as will give to the sealing-wax a beautiful white appearance resembling enamel. A special effort should be made to obtain this appearance in all other varieties also, with the exception of transparent sealing-wax, as seals made with such sealing-wax are the most beautiful.

Chalk.

Chalk occurs, as a mineral, in many places in such masses as to form regular mountain-chains. The coast of a great part of England, the island of Rugen, etc., consist of chalk-cliffs. Chalk consists essentially of the same substances as white marble, that is, of carbonate of lime. It presents very peculiar forms under a strong magnifying glass, and we know now that all chalk has been formed from the remains of minute animals or plants, in whose shells the mineral substance was present.

Chalk, as found in nature, contains many inclosures, such as flints, sand, petrifications, etc., and, therefore, must be especially prepared before it can be used for the various purposes for which it is employed (for writing, paints, etc.). Chalk is prepared by grinding and washing it, and by forming the powder into a dough with water, to which has been added a very small quantity of some kind of paste. This is then dried and cut into pieces, and furnishes the chalk for writ-

ing. For our purposes it is sufficient to wash the chalk, and to dry the powder. The principal property of chalk, fit to be used for the fabrication of sealing-wax, consists in its pure white color.

Gypsum

is also a frequently occurring mineral. Only the whitest, finely ground gypsum, the so-called burned (*i. e.* dephlegmated) gypsum, such as the moulders of plaster of Paris figures use, can be employed in the fabrication of sealing-wax. The variety of gypsum occurring in colorless crystals, and known by the name of specular gypsum or selenite, is used for the transparent variety of sealing-wax. Before using the selenite, it must be powdered and washed.

Carbonate of Magnesia

is found in commerce as a dazzling white, very fine powder, which is uncommonly light. Magnesia, being dense and at the same time of a yellowish color—caused by a small quantity of sesquioxide of iron contained in it—is of less value. Carbonate of magnesia is especially valuable to the manufacturer of sealing-wax on account of its light weight, and is particularly used as an addition to such sealing-wax as is compounded with heavy pigments.

Zinc-White

is found in commerce as a milk-white, fine powder, and can be used without further preparation.

Sulphate of Baryta (Permanent White).

This white pigment, distinguished by its great weight and unchangeableness, can be procured in commerce, but the price asked is so high that it is more advisable for the manufacturer to prepare it himself. It is especially adapted for preparing white, enamel-like varieties of sealing-wax.

Sulphate of baryta is prepared by dissolving chloride of barium in rain water, and by adding sulphuric acid to the solution as long as a precipitate is formed. On account of its great weight, the thus-formed precipitate of sulphate of baryta (permanent white) settles quickly to the bottom and forms an uncommonly delicate powder of a dazzling white color. The water is poured off from the precipitate and clean water is poured over it, the process being repeated several times. When the precipitate has been sufficiently washed, it is dried.

Nitrate of Bismuth, or Flake-White,

produces the most beautiful white color, but commands a high price. For this reason it is advisable for the manufacturer to prepare this pigment also himself, especially as it can be done with very little trouble. Nitrate of bismuth, or flake-white, is obtained in the following manner: Bismuth is placed in a glass vessel and fuming red nitric acid is poured over it. The acid has a strong effect upon the metal, suffocating reddish-brown vapors are formed and the bismuth is gradually dissolved.

When the bismuth has been entirely dissolved, the contents of the glass are poured into a vessel containing about one hundred times the quantity of rain water and stirred. The entire fluid assumes at once a milky appearance, and in a few hours the nitrate of bismuth will have settled to the bottom in the form of a white powder. This is then washed and dried. The fluid standing over the precipitate still containing some bismuth in solution is evaporated until crystals are formed, and these are again dissolved in nitric acid and the operation is repeated. The nitrate of bismuth or flake-white obtained in this manner furnishes the most beautiful, enamel-like, white sealing-wax.

Bronze-powder

in all possible shades is also used as an addition to various kinds of sealing-wax. Finely powdered mica is used for the cheaper, so-called aventurin sealing-wax, which shows yellow or white spangles of a metallic lustre in a transparent ground-mass. Mica is a frequently occurring mineral which as is well known is also used as a sand for drying ink.

All the materials used in the fabrication of sealing wax, whether they are resins or pigments, must be thoroughly dried before they are used. To save the expense of a special apparatus for drying these materials, it is advisable to utilize for this purpose the heat developed by the stove upon which the mass for the

sealing-wax is melted. For this purpose a shelf is placed all around the walls, about 50 centimeters (19.7 inches) below the ceiling, of the room in which the stove stands, and the materials, resins, chalk, magnesia, pigments, etc., are put up in paper bags and placed upon this shelf. As the warm air arising from the stove always goes up to the ceiling of the room, the materials will be sufficiently dried when they remain for a few days in this warm air.

The mass for sealing-wax is prepared in the following manner: The actual raw materials, namely, the resins and turpentine, are first melted in suitable vessels, then the indifferent substances, such as chalk, magnesia, etc., are stirred into the fluid mass, and finally the pigments are added. If the mass is to be perfumed with balsam of Peru or essential oils, they are added immediately before the ready mass is to be formed into sticks, as they are very volatile.

If only one pigment alone, for instance cinnabar, chrome-yellow, or Berlin blue, is to be used, nothing else is to be done but to add the pigment, which has been first somewhat warmed, to the mass and to incorporate it with it thoroughly by continual stirring. But where certain shades of color, such as rose-color, violet-blue, or mixed colors, such as orange, green, or violet, are to be produced, a somewhat different method has to be used.

No white substances are then added to the resins, but they are kept back and mixed with the coloring substances in a porcelain dish large enough to hold the

entire quantity of white substance and coloring substance to be used. The dish is placed upon a stove so that the materials may become warm, as they can be easier incorporated with the melted mass of resin. For lighter shades, for instance, rose-color, a dark red pigment such as madder-lake is mixed with a sufficient quantity of the white substance to give to the mixture a far darker color than is desired for the sealing-wax, as the shade of color desired for the ready sealing-wax can be easily produced by gradually adding white substance and by frequent testing.

Any of the previously mentioned white substances can be used for producing a lighter shade of color, and by increasing the quantity of them all possible gradations of color may be obtained. In a similar manner all shades of orange can be obtained by a suitable mixing of yellow with red, of green by mixing yellow with blue, of violet by mixing red with blue. For gray a small quantity of black is added, etc. etc. It must be left to the experience of the workman to hit the right shade of color by a suitable mixing.

II.

MELTING THE SEALING-WAX MASS.

This is the most particular work of all in the manufacture of sealing-wax. It must be accepted as a principle in regard to this work, that the mass should

be melted at as low a temperature as possible, and the heat should never be greater than is required to keep the mass in a fluid state. This object can be attained only by working a not too large quantity of sealing-wax at one time in the melting vessel. We generally use vessels in which can be prepared about 10 kilogrammes (22 lbs.) of ready sealing-wax, and large enough to allow the mass to be quickly stirred.

Many manufacturers melt the mass upon a furnace constructed like a common cook-stove, where the fire heats cast-iron plates upon which the articles to be heated are placed. But we consider such a stove as a very incomplete apparatus, as it is impossible to uniformly heat the entire surface of the plates, as those exposed most to the fire are generally already red hot while the more distant plates are scarcely warm. But independent of these evils such stoves are always somewhat dangerous on account of fire. One drop of the fluid mass when this is ladled out may fall upon the hot plates, may become ignited, and communicate the flame to the contents of the melting vessels, and though a fire might be prevented by quickly covering the vessels, yet the mass would be spoiled in most cases, because burning sealing-wax turns black.

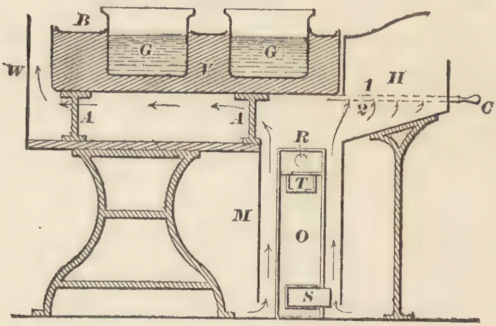
We have constructed a melting apparatus where the evils above mentioned are avoided, and it is possible to regulate the temperature so accurately that it will not rise higher than is actually required. This apparatus serves at the same time for the so-called polish-

ing of the sealing-wax, and therefore, does away with the necessity of building a special polishing apparatus. Figure 11 represents a cross section of such an apparatus.

The Melting Apparatus.

This consists of a small furnace, *O*, about one meter (3.28 feet) high; the upper door *T* serves for introducing the fuel, for which purpose it is best to use small pieces of coke such as is furnished by gas works.

Fig. 11.



The lower door can be either partly opened or entirely closed by a slide *S*, by which the consumption of the fuel can be regulated. There is no grate in this stove; the ashes can be removed through the lower door. The gases of combustion pass into the chimney through the pipe *R*.

The stove is entirely surrounded by a sheet-iron casing *M*, which stands at a distance of about 5 centi-

meters (1.96 inches) from the stove, and the same distance from the floor. The air between the casing and the stove becomes hot, ascends in the direction indicated by the arrows, and is replaced by cold air flowing in between the casing and the stove.

Alongside of the casing of the stove and connected with it stands a table surrounded on all sides by a sheet-iron screen *W*. Upon the table stands a sheet-iron tub *V* filled with sand, and resting upon iron supports *A*. The tub is covered with a sheet-iron plate *B*. In this plate are four or six round holes in which the melting vessels *G* are placed in two rows. On the bottom of the polishing hearth *H* is a plate 1, which is cut in such a manner as to give it the appearance of a grate. Underneath this plate is a similar one 2, which can be shifted by the handle *C* in such a way that the cuts in the two plates cover each other. If it is desired to use all the available heat for melting, the cuts in plate 1 are closed by shifting plate 2.

The hot air arising from the stove heats the tub *V* and the sand contained in it, and the mass of sealing-wax contained in the vessels *G* commences to melt. As soon as it is melted the fire in *O* is moderated by partly closing the lower opening by the slide *S*, and it is possible to keep the mass for a long time in a fluid state without a stronger heat being required, as the hot sand retains the heat. The sheet-iron plate *B* which covers the sand is placed there for preventing the loss of such sealing-wax as might accidentally drop in ladling it out of the melting vessel.

Well-enamelled cast-iron pots of the shape shown in the illustration should be used for melting, and a special pot for every mixture. If a pot has to be used for a differently colored mass, it should first be allowed to become entirely cold, when the sealing-wax still adhering to the sides can be easily removed from the smooth surface.

The melting is done by first placing the shellac in the pot and melting it under continual stirring with a flat paddle of hard wood. The turpentine is then added and intimately mixed with the shellac. Then the remaining substances, such as chalk and coloring matter, are dropped in a thin stream into the melted mass, which from this time on should be stirred uninterruptedly. Quick stirring is absolutely necessary, especially when very heavy coloring substances are used, as these easily sink to the bottom.

When the entire mass seems to be uniform, it is examined by lifting the paddle and catching the dropping sealing-wax upon a cold, smooth plate of sheet-metal, where it quickly solidifies, and can then be examined in regard to color, hardness, and fracture. If the mass is found satisfactory, the fire is sufficiently moderated to keep it in a melted state, the substances for perfuming the wax are quickly stirred in, and the forming of the sticks is immediately proceeded with.

III.

FORMING OR MOULDING THE SEALING-WAX.

Special forms are required to shape the sealing-wax into sticks. These consist of one piece for rectangular, square, or triangular sticks, but must be of two pieces for round or oval sticks. In the latter case, one-half of the form is provided with holes into which fit protuberances on the other half to prevent the form from shifting. When the forms are used for moulding, the two halves are firmly pressed together by a screw-clamp.

The forms which consist of one piece are made of rectangular brass plates, in which are hollowed out lengthwise channels about 1 millimeter (0.039 inch) wider on the top than on the bottom, as this will very much facilitate the lifting out of the cold sticks. As both ends of the channels are left open, iron plates are laid on the narrow ends of the form to prevent the sealing-wax from running out when poured into the channels. These forms are generally twice as long as the sticks of sealing-wax found in commerce.

The forms consisting of two pieces, each half of which forms a half-cylindrical channel which, when the form is closed, form an entire cylinder, stand generally upright when used for moulding. They are, therefore, made somewhat broader on the bottom, and

are set upon a level metal plate. These forms are only as high as the stick of sealing-wax is to be long.

Many manufacturers place the forms upon a stone, or cool them off while moulding, by laying them upon boxes of sheet-metal filled with cold water for the purpose of congealing the mass as quickly as possible. Of course, by employing this method, the forms can be used again in a very short time after each moulding, but the sticks of sealing-wax become too brittle. We, therefore, prefer not to cool the forms off, but to place them upon a wooden table. We cool the form off only by dipping it in cold water, and carefully drying it, when it has become so hot that the sealing-wax would require a long time for congealing.

The work of lifting out the congealed sticks is easily accomplished, if the forms are entirely plain, but if they are engraved, they must be touched up for a long time before the sticks can be lifted out clean. In such cases it is advisable to slightly rub the engraved places with oil of turpentine. If the sealing-wax is to be gilt or silvered on certain places, the gold-leaf or silver-leaf is placed in the form, or it is dusted with bronze powder.

When made of brass the forms for moulding sealing-wax are rather expensive on account of the cost of engraving. But they can be constructed very cheaply by a simple method, and only one single form is required for the purpose, but this must be worked in a faultless manner. A stick of fine sealing-wax is

moulded in this form. Fine olive oil in as thin a layer as possible is then rubbed over the surface of the stick of sealing-wax. This is done with a tuft of fine cotton. The oiled stick is laid in a longish form and plaster of Paris is poured over it. When this has become hard it is carefully detached from the stick and thoroughly dried out at a moderate heat. It is then rubbed over with olive oil and a stick of plaster of Paris is moulded in it, which resembles in every respect the first casting of sealing-wax. When the stick of plaster of Paris has been thoroughly dried, it is placed in a small wooden box and melted type-metal is poured over it, but this must not be heated any more than is absolutely necessary to bring it to the melting point. In this manner forms of type-metal are obtained which can be used like the brass forms. Many copies can also be made from a single form by the galvano plastic process.

The moulding process is carried on in the following manner: The melted sealing-wax is taken from the melting vessel with a ladle and poured into a casting-ladle which is provided with a spout and a wooden handle, and which has been previously heated. From this it is poured into the forms in a uniform stream. The forms consisting of one piece are covered with a board when the sticks have become cold, they are then turned over and the sticks are detached from the channels of the forms by a gentle knock. Forms consisting of two pieces are opened and the sticks pushed out. In regard to these forms it may be mentioned

that clean moulded sticks can only be obtained by slightly heating the form. The form should therefore be gently heated before the first casting, which can be done in the simplest manner by placing it up the plate *B* of the melting apparatus.

Variegated sealing-wax which should show a marbled surface is prepared by moulding sticks about as thick as a quill and placing them alongside of each other. They are then sufficiently heated to become soft, are twisted regularly together into spiral lines and rolled into a cylinder upon a smooth stone slab.

IV.

POLISHING THE STICKS OF SEALING-WAX.

Only the finer qualities of sticks of sealing-wax obtained from the forms show a certain lustre upon their surfaces. Poorer qualities do not possess this lustre, but it must be imparted to them by a special operation which is called polishing, dressing, and also enamelling. As nearly every kind of sealing-wax bears an inscription or stamp, the stamping is done at the same time as the polishing. The finer sorts are generally also polished, though as a rule they come from the form in a smooth state.

In older factories there are special polishing stoves for this purpose. These consist of a nich built of brick. On the bottom of this is an iron plate which is

strongly heated by a fire made under it and heating also the air in the nich. We gain the same object by the contrivance *H* shown in Fig. 11, which consists of a box of sheet metal or wood open in front and into which hot air is admitted by shifting the plate 2. The air need only be hot enough to melt the surface of the sticks of sealing-wax in a short time.

The polishing process is carried on in the following manner: A workman holds a number of double sticks, without one stick touching the other, half-way into the polishing stove until the surface of the sticks commences to melt and the sticks themselves become bent. When this takes place, he places the sticks before a workman sitting opposite to him. He pushes the sticks upon a small board lying before him, and with the left hand presses another small board upon the second length of the stick and imprints the stamp. It is necessary to hold the sticks between these two small boards, as their shape is easily destroyed, especially if they are very soft and the "stamper" uses too much force in imprinting the stamp. When they have been stamped, the first workman takes them again and holds the other half which has not yet been polished in the polishing stove, and then the second workman stamps these also. The stamps consist of brass frames in which the single letters of which the inscription is composed are placed and held in place by a screw, or they consist of an engraved brass-plate. The last-named stamps serve generally

the purpose of imprinting ornamentations and arabesques upon the sticks.

The double sticks are now cut apart. This is done in the following manner: 30 to 40 sticks are laid alongside of each other, and are scratched exactly in the centre with a sharp knife and by using a ruler. They are then turned over and scratched on the other side also. If both scratches are exactly opposite to each other the sticks can be easily broken smoothly apart on these places, and the fractures need only be slightly polished to finish the article.

If ready sticks of sealing-wax are to be gilded or silvered, it is only necessary to touch the respective places with a brush dipped in strong spirit of wine, and to apply the gold-leaf or silver-leaf, which will then adhere very tenaciously. The sticks can also be bronzed in a similar manner.

V.

RECEIPTS FOR SEALING-WAX.

There are a great number of receipts according to which one or the other kind of sealing-wax is to be prepared. In the following we give only a comparatively small number, but all of them have produced good results. This is the case even with the cheaper qualities, which, under the name of parcel-wax, are used for sealing packages, although, of course, they

do not possess the excellent properties of those fine sealing-waxes which are prepared by using the finest materials.

Red Sealing-wax.

As is well known, red sealing-wax is the most used of all the varieties of sealing-wax. Its beauty and its price are determined by the quantity of shellac and cinnabar contained in it; only the finest qualities contain cinnabar exclusively as a coloring principle. The inferior kinds contain very little shellac, but much common resin, and no cinnabar at all; minium, colcothar, bole, or other cheap pigments are substituted for the latter.

But we must lay it down as a general rule that not too much resin must be added to the sealing-wax, or else the latter will become too thinly fluid, drop too easily, and smoke very much when lighted. Many manufacturers assert that chalk should not be used, because the acids of the shellac expel carbonic acid from it and form a combination with the lime. But this happens only when the shellac is heated more than is necessary. No carbonic acid is set free if the shellac is only heated to the melting point, and it is not required for our purposes to heat it any further.

A. *Very Fine Red Sealing Wax.*

I.

	Parts.
Shellac	120
Turpentine	80
Cinnabar	90
Oil of turpentine	20
Magnesia	30

II.

	Parts.
Shellac	110
Turpentine	60
Oil of turpentine	10
Chalk	10
Magnesia	20
Cinnabar	80

III.

	Parts.
Shellac	100
Turpentine	10
Oil of turpentine	5
Chalk	15
Gypsum	15
Magnesia	2
Cinnabar	65

B. *Medium Fine Red Sealing-Wax.*

I.

	Parts.
Shellac	10
Turpentine	80
Oil of turpentine	4
Chalk	30
Magnesia	10
Cinnabar	60

II.

	Parts.
Shellac	60
Resin	40
Oil of turpentine	4
Turpentine	70
Chalk	15
Gypsum	15
Cinnabar	45

III.

	Parts.
Shellac	40
Resin	60
Turpentine	60
Oil of turpentine	5
Chalk	20
Gypsum	10
Cinnabar	40

C. *Common Parcel Wax.*

I.

	Parts.
Shellac	35
Resin	65
Turpentine	50
Oil of turpentine	5
Chalk	25
Gypsum	10
Cinnabar	25

II.

	Parts.
Shellac	20
Resin	80
Turpentine	50
Oil of turpentine	5
Chalk	30
Gypsum	5
Minium	60

Very Common Parcel Wax.

	Parts.
Shellac	15
Resin	85
Turpentine	60
Oil of turpentine	5
Chalk	20
Brick dust	10
Colcothar	50

R. Wagner's Receipts for Preparing Sealing-Wax.

A. *Fine Red Sealing-Wax.*

	I. Parts.	II. Parts.	III. Parts.	IV. Parts.	V. Parts.
Shellac	550	620	550	700	760
Turpentine . . .	740	680	600	550	410
Chalk or magnesia . .	300	200	..	..	..
Gypsum or zinc-white .	200	..	..	..	..
Sulphate of baryta . .	..	100	380	300	320
Cinnabar . . .	130	220	340	300	540
Oil of turpentine . .	..	..	..	20	40

B. *Ordinary Red Sealing-Wax.*

	I. Parts.	II. Parts.	III. Parts.	IV. Parts.	V. Parts.
Shellac	520	490	620	710	740
Turpentine . . .	600	580	520	600	420
Pine resin . . .	440	440	320	210	160
Chalk	180	..	..	100	..
Sulphate of baryta . .	..	320	300	..	120
Cinnabar . . .	180	130	200	400	520

C. *Black Sealing-Wax.*

	I. Parts.	II. Parts.	III. Parts.	IV. Parts.	V. Parts.
Shellac	480	560	660	740	680
Turpentine	520	440	420	380	360
Pine resin	460	500	400	340	300
Chalk	280	180	140	140	150
Soot	80	..	..	..	..
Bone-black	..	420	300	300	320
Asphaltum	..	..	..	..	200

Parcel-Wax.

	Parts.
Colophony	2000
Pine resin	1000
Turpentine	500
Chalk	750
Oil of turpentine	30

For brown, 1000 parts umber or 1000 parts bole are added to this mass.

Yellow Sealing-Wax.

Only lead colors can be used for yellow sealing-wax, and of these chrome-yellow produces the most beautiful color. But if sealing-wax compounded with chrome-yellow is very strongly heated in lighting it, the mass becomes discolored, in consequence of a decomposition of the lead colors. Therefore, yellow sealing-wax must be very fusible to avoid this evil. Every kind of sealing-wax becomes more fusible by adding a larger quantity of turpentine, but it also becomes less hard the more turpentine is added.

Fine Yellow Sealing-Wax.

	Parts.
Shellac	76
Turpentine	85
Pine resin	45
Gypsum	15
Chalk	15
Ochre	45

The shellac used for fine qualities of yellow sealing-wax must be bleached, or else it will be impossible to produce a pure tone of color. All gradations of yellow, from orange to red, can be produced by adding cinnabar or chrome-red to fine qualities and minium to inferior qualities of sealing-wax.

Green Sealing-Wax, I. (Fine).

	Parts.
Shellac	70
Turpentine	80
Pine resin	40
Magnesia	15
Berlin blue Chrome-yellow	25

Green Sealing-Wax, II. (Ordinary).

	Parts.
Shellac	50
Turpentine	40
Pine resin	80
Gypsum	15
Chalk	20
Mountain blue Ochre	30

Green ultramarine may also be used to great advantage for the finer qualities, instead of a mixture of colors, and it is a sufficiently good substitute for the dear green cinnabar and chrome-green. We have not

given separate quantities of blue and yellow pigment to be used, as the different shades of green may be obtained by varying the quantities of each.

Blue Sealing-Wax.

	Parts.
Shellac	70
Turpentine	60
Pine resin	35
Magnesia	10
Chalk	20
Blue coloring matter	20 to 25

Light-colored ultramarine or mountain blue is used for light-blue varieties, Berlin blue for the darker kinds. Blue sealing-wax of a lighter color, produced by mixing Berlin blue with oxide of zinc or nitrate of bismuth, has a very beautiful enamel-like appearance. As blue colors are very sensitive towards admixtures, bleached shellac should always be used if it is desired to obtain sealing-wax of a beautiful color, and the greatest care must also be exercised in the choice of the pine resin. Entirely opaque and brown-colored resin must never be used. It must be laid down as a general rule to use only light-colored materials for fine yellow, light-red, green, blue, and violet kinds of sealing-wax, so that the purity of tone of the color may not be impaired.

Brown Sealing-Wax.

	Parts.
Shellac	70
Turpentine	60
Pine resin	40
Gypsum	20
Chalk	20
Umber	20

The shellac used for preparing the tender chocolate-brown sealing-wax must not be too dark. The product of the above receipt is dark-brown, and unbleached shellac and dark resin may be used for preparing it. Of course the same holds good in an equal degree in regard to the following varieties:—

Black Sealing-Wax, I.

	Parts.
Shellac	50
Turpentine	90
Pine resin	65
Chalk	40
Soot	12

Black Sealing-Wax, II.

	Parts.
Shellac	80
Turpentine	60
Resin	60
Chalk	15
Gypsum	10
Vine-black	35

By following the above receipts, the intelligent manufacturer will have no difficulty in preparing mixtures of various colors corresponding to a certain degree of fineness.

For preparing sealing-wax of different shades of color, which present an especially beautiful appearance when the differently colored single sticks are laid along-side of each other like a scale of colors, it will be advisable to arrange a normal scale of colors consisting of single sticks, the coloring of which has been especially successful. The shading of the colors in this scale must harmonize, and the sticks lying alongside of each other must show, for instance, all gradations from white through rose-color to the darkest, most fiery red, which is prepared with madder lake.

For one still inexperienced, it is difficult to produce these shades of color by a suitable mixing of the coloring substances; but this can be easily acquired by a simple knack. We will take red sealing-wax as an example which can be prepared in different shades from the tenderest rose-pink to dark red.

The respective scale of red colors is first painted upon paper with a good water-color; this scale serves for comparing the test-samples of sealing-wax.

Further, a certain quantity of entirely white sealing-wax (1 kilogramme) (2.2 lbs.) is melted, and the same quantity (1 kilogramme) of finely powdered sealing-wax of as dark a red color as possible is held in readiness. The latter is added to the

white sealing-wax until a test sample shows the shade which is desired according to the painted scale. If now the remainder of the powdered red sealing-wax is weighed, we know exactly how much must be added to the white mass to produce the desired red shade of color.

If the white and the red ground mass are produced according to this direction, and mixed according to the proportions obtained in the above-described manner, exactly the same shades of color will always be obtained.

The same method is followed with all other colors, and by a little attention the manufacturer may acquire a collection of directions by which he can produce sealing-wax of every imaginable color.

Specialties in Sealing Wax.

By specialties we understand here certain kinds of sealing-wax which are used exclusively for certain purposes, such as sealing-wax for bottles, or such as are in less demand, as transparent sealing-wax, aventurin sealing-wax, etc.

Sealing-wax for Bottles

belongs to the most ordinary sorts of sealing-wax, and of course can only be colored with the cheapest kinds of coloring matter. Many manufacturers prepare sealing-wax for bottles of a mixture of common pine resin, turpentine, chalk, and the respective coloring matter only. To be sure these kinds of sealing-wax are very cheap, but they do not answer the purpose as well as

they should. As is well known, the corks are covered with a layer of sealing-wax by dipping the necks of the bottles into the melted mass. This congeals very quickly on coming in contact with the cold glass, and in consequence of this, at once becomes more brittle and frequently breaks when gently touched. If it is tried to make the sealing-wax less brittle by increasing the quantity of turpentine, it happens very frequently, that it remains sticky even in cold weather.

To avoid these evils, nothing else can be done, but to add a certain quantity of shellac, 10 to 15 per cent., to the composition. This will increase the cost of the article somewhat, but its quality will be so much improved, that it will not become sticky even if exported to a hot climate.

It may here be mentioned that the demand for sealing-wax for bottles has lately fallen off very much as many wine dealers, liquor manufacturers, etc., prefer not to coat them with it, but to cover the corks with metal caps instead.

Transparent Sealing-Wax.

Transparent, or more correctly translucent sealing-wax, belongs to the very finest qualities, as only very much refined materials can be used for preparing it. Bleached shellac alone is not sufficient; sealing-wax only becomes transparent by adding a corresponding quantity of mastic, and by using only very fine, light colored, and very viscid turpentine.

In the following, we give three receipts for preparing

such masses for sealing-wax, which may be colored as desired by mixing suitable coloring matter with it. A very beautiful variety, and which can be prepared at a comparatively low cost, is the so-called aventurin sealing-wax, which is obtained by stirring finely powdered yellowish or bronze-colored mica into the melted ground mass.

Gold or silver sealing-wax is obtained by mixing finely powdered leaf-metal with the melted ground mass.

Ground Masses for Translucent Sealing-Wax.

I.

	Parts.
Bleached shellac	15
Viscid turpentine	15
Mastic	30
Chalk	10

II.

	Parts.
Bleached shellac	30
Viscid turpentine	35
Mastic	40
Zinc-white	20

III.

	Parts.
Bleached shellac	30
Viscid turpentine	40
Mastic	50
Sulphate of baryta	30
(Or nitrate of bismuth)	30

The last named mixture, No. III., is especially adapted for preparing the very beautiful so-called enamelled sealing wax, which actually possesses the half-transparent appearance of enamel. This mixture is especially beautiful when a tender rose-color is given to it by using fiery madder-lake. A seal made with this sealing-wax, bears great resemblance to a cameo.

Sealing-Wax for Deeds, etc.

As is well known, very large seals, for deeds, public documents, etc., are not imprinted in ordinary sealing-wax, but a mass which is half soft, even at an ordinary temperature, the actual sealing-wax, is used for the purpose, and to protect the seal from injury, it is inclosed in a special case which is fastened to the document by cords or ribbons. In the following, we give three receipts for preparing this sealing-wax, and would remark that the product prepared according to the second receipt is very suitable for a so-called embossing-wax for engravers.

Sealing-Wax I.

	Parts.
Light-colored colophony	60
Turpentine	35
Clarified tallow	30
Whitening	40
Minium	30 to 40

Sealing-Wax II.

	Parts.
White wax	50
Turpentine	15
Cinnabar	10
Glycerine	5

In both cases, the ingredients are melted together and stirred while cooling off until they congeal.

Sealing-Wax III.

	Parts.
Colophony	3
Tallow	1.5
Turpentine	3
Chalk	4
Minium	4

This mixture is of considerable consistency at an ordinary temperature, but if a piece of it is held in the hand for some time, it becomes so soft that impressions can be taken with it, and it adheres also with considerable tenacity to paper, wood, and glass.

APPENDIX.

Blue Lacquer.

Lately a receipt for preparing an excellent and beautiful blue-black lacquer has been frequently advertised as a so-called trade-secret, and high prices have been asked for making known the ingredients. The lacquer in question, which derives its name "blue lacquer" from the substance known as Paris blue used in preparing it, possesses the highest degree of elasticity or rather tenacity of all lacquers which have been proposed for lacquering leather, and imparts to it a glossy black color. Blue lacquer is prepared in the following manner: Good linseed oil is boiled with 5 to 10 per cent. of the finest Paris blue until a test sample of the mass, which assumes an intensely black color during the boiling, forms a tenacious and glossy mass when applied to a piece of leather when it has become cold.

The ready lacquer is poured off from the undissolved Paris blue which can again be used for another operation. The lacquer is used by drying the leather to be coated with it at a temperature of between 40° and 50° C. (104° and 122° F.). Properly prepared blue lacquer should remain so tenacious when it has become dry that a piece of leather coated with it may be strongly bent repeatedly without cracking the lacquer.

This lacquer, as may be seen by the foregoing description, can be prepared in a simple manner and at the same time at small expense, but we will call attention to a few knacks which are absolutely necessary for the work to be successful.—The Paris blue to be used must be *perfectly pure*, i. e. no foreign substances must be mixed with it; when a sample of it is burned upon sheet-metal only a small heap of yellowish-brown ashes must finally remain. Special attention must be paid that the Paris blue is thoroughly dried before it is added to the oil. It is best to dry it after it has been powdered by spreading it in a thin layer upon a piece of paper and placing it upon the plate of a stove. The oil to be used should be as old as possible and entirely clear, and the blue lacquer should always be boiled in the same pot, which, after the work has been finished, is set aside without cleansing, but simply covered with paper. When the pot is to be used for another operation, it is advisable to pour some linseed oil upon the undissolved sediment and to stir it thoroughly to prevent it from burning.

By accurately observing these directions a faultless blue lacquer of excellent quality and beauty will always be obtained.

THE ART

OF

VARNISHING AND LACQUERING.

Section I.

The art of varnishing and lacquering includes first the preparing of putties and stains, then a description of the apparatus and tools used, rules which must be observed in varnishing and lacquering, and the means for pumicing, polishing, etc. In short, it is the art of applying colors, varnishes, and lac-varnishes to articles of wood, sheet metal, and leather, and drying, pumicing, and polishing them.

Preparation of Putties required for the Varnishing and Lacquering.

Putties serve for making surfaces of wood even, for filling np holes, etc., and are used before the stains and varnishes are applied.

1. *Thompson's Glue Putty.*

125 grammes (4.38 ozs.) of good glue are boiled in 1 kilogramme (2.2 lbs.) of water until the glue has

been dissolved. Then 5 grammes (0.175 oz.) of powdered alum and 180 grammes (6.3 ozs.) of rye flour are added to the glue water and thoroughly mixed with it. On the other hand, three to four sheets of blotting paper, which have first been torn into small pieces, are placed in a dish with finely sieved sawdust. Enough of these substances is kneaded into the glue paste to form a tenacious putty with which all the crevices and holes in the wood can be filled up.

2. *Putty with Linseed-oil Varnish.*

White lead, umber, minium, and litharge are mixed to a tenacious dough with thoroughly boiled linseed-oil varnish, to which has been added a little amber varnish, and the putty thus obtained is placed in the holes with a wooden spatula.

3. *Putty of Isinglass and Chalk.*

Isinglass is dissolved in water, and finely powdered chalk is added to the solution until a thick paste is formed. The cracks, joints, and holes of the wood are then filled up with this putty.

4. *Filling Up.*

This filling color for carriages originated in England, and has lately come into extensive use in all carriage factories, as it answers the purpose very well for which it is intended. It has a gray to brown color, and is prepared by grinding in a machine.

	Parts.
Filling up	15
White lead	3
Chalk	2
Siccative	4
Oil of turpentine	2

SECTION II.

Preparation of Stains to be used in the Art of Varnishing and Lacquering.

Wood and other articles of horn, bone, and ivory are stained for the purpose of giving to them a more beautiful color. According to their composition, the stains are applied either cold or warm with a sponge, or the articles themselves are immersed in the stain. Wood which is naturally veined, becomes especially beautiful by holding it over a coal-fire and gently heating it before a warm stain is applied. It acquires by this very beautiful dark and light streaks. The wood which is to be stained may also be placed in a boiler. The liquor is then poured over it, and boiled until the color has thoroughly penetrated the wood.

I. *Mahogany Stains.*

1. Madder . . 500 grams. (17.5 ozs.)
   Rasped yellow wood 250 grams. (8.75 ozs.)

are boiled for one hour in 2.50 kilogrammes (5.5 lbs.) of water, and the boiling liquor is applied to the arti-

cles of wood until the desired color has been produced.

2. Powdered turmeric . 30 grams. (1.05 ozs.)
   Powdered dragon's-blood 30 grams. (1.05 ozs.)

are digested in 250 grammes (8.75 ozs.) of 80 per cent. strong alcohol, and when the latter seems to be thoroughly colored, it is filtered through a cloth. The filtrate is heated and applied warm to the wooden article.

3. Madder . . . 500 grams. (17.5 ozs.)
   Ground logwood . 250 grams. (8.75 ozs.)

are boiled for one hour in 2.50 kilogrammes (5.5 lbs.) of water. This is filtered while still warm, and the warm liquor is applied to the wood. When this has become dry and it is desired to produce a darker mahogany color, a solution of 15 grammes (0.525 oz.) of carbonate of potassa in 2 kilogrammes (4.4 lbs.) of water is applied to the wood. This solution is prepared cold, and filtered through blotting-paper.

4. 10 grammes (0.35 oz.) of aniline are dissolved in 250 grammes (8.75 ozs.) of spirit of wine 90 per cent. strong. Then another solution of 10 grammes (0.35 oz.) of aniline yellow in 500 grammes (17.5 ozs.) of spirit of wine 90 per cent. strong is made, and this is added to the aniline solution until the required reddish-yellow color is obtained. By adding a little of a solution of aniline brown (10 grammes (0.35 oz.) of aniline brown in 300 grammes (10.5 ozs.) of spirit of wine 90 per cent. strong), the color is still more completely harmonized, and a color very closely resem-

bling mahogany can be given to elm and cherry wood with this mixture.

5. A new stain very suitable for imitating wood is prepared as follows, according to E. Pfuscher:—

20 grams. (0.7 oz.) of logwood

are boiled in 100 grammes (3.5 ozs.) of water down to about one-half. This is then filtered, and 3.5 grammes (0.12 oz.) of chloride of baryta are dissolved in it.

II. *Red Stains.*

1 kilogramme (2.2 lbs.) of finely powdered Lima red dye-wood and 60 grammes (2.1 ozs.) of carbonate of potassa are put in a glass bottle and digested in 2.5 kilogrammes (5.5 lbs.) of water for eight days in a warm place; the bottle should be frequently shaken. It is then filtered through a cloth, the fluid is heated and applied to the article to be stained until the latter acquires a beautiful red color. If it is desired to brighten the color, a solution of 60 grammes (2.1 ozs.) of alum free from iron in 1 kilogramme (2.2 lbs.) of water is applied to the article while it is still wet. The last solution can be prepared by heat; when it has been accomplished, it is filtered. As soon as the stains have become dry they should be rubbed with a rag moistened with linseed oil, after which the varnish may be applied.

2. *Purple Stain.*

1 kilogram. (2.2 lbs.) of rasped logwood,

2.50 kilograms. (5.5 lbs.) of rasped Lima red dye-wood,

are boiled for one hour in 2.50 kilogrammes (5.5 lbs.) of water. It is then filtered through a cloth and applied to the article to be stained until the desired color has been obtained.

In the mean while a solution of

5 grams. (0.175 oz.) of carbonate of potassa in
500 grams. (17.5 ozs.) of water

has been prepared, and a thin coat of this is applied to the article stained red. But strict attention must be paid not to apply too thick a coat of this solution, or else a dark blue color would be the result.

3. *Red Stain for Horn, Ivory, and Bone.*

500 grammes (17.5 ozs.) of red Brazil-wood are boiled for one hour in 2 kilogrammes (4.4 lbs.) of milk of lime and filtered through a cloth. The articles of horn, ivory, or bone, to be stained are boiled for one hour in a solution of 30 grammes (1.05 ozs.) of alum in 500 grammes (17.5 ozs.) of water. They are then placed in the above stain, and allowed to remain there until the desired color has been produced. Articles stained in this manner will acquire a beautiful purple color by dipping them in alum-water.

4. *Purple Stains for Horn, Ivory, and Bone.*

500 grammes (17.5 ozs.) of logwood are boiled in 2 kilogrammes (4.4 lbs.) of milk of lime, and the same method is observed as given in No. 3.

5. *Bright Red Stain for Horn, Ivory, and Bone.*

250 grams. (8.75 ozs.) of logwood, and
250 grams. (8.75 ozs.) of red Brazil-wood
are boiled in 2 kilogrammes (4.4 lbs.) of milk of lime. It is applied in the same manner as the foregoing.

6. *Bright Red Stain for Bone and Ivory.*

This is prepared by dissolving
1 gram. (0.035 oz.) of genuine carmine in
30 grams. (1.05) ozs.) of sal ammoniac
by heating it gently. This stain is used warm, and in such a manner, that the articles to be stained remain for a few hours in the fluid and should be frequently turned while there. The polishing is generally done with some soap-water and finely powdered chalk.

7. *Red Stain for Leather.*

250 grams. (8.75 ozs.) of shavings of red Brazil-wood are placed in a bottle, 1 kilogram. (2.2 lbs.) of wine vinegar is poured over them, and they are digested for eight days, and stirred frequently in the mean while. The solution is then filtered through a cloth.

In the mean while a solution of
30 grams. (1.05 ozs.) of alum free from iron in
250 grams. (8.75 ozs.) of water
is prepared, and the above preparation of Brazil-wood is added to this under constant stirring. A very beautiful red is obtained in this manner. The shav-

ings of Brazil-wood may also be boiled in rain water, and this be compounded with a solution of bitartrate of potassa.

8. *Cochineal Stain for Leather.*

30 grams. (1.05 ozs.) of the finest cochineal are powdered and digested in 500 grammes (17.5 ozs.) of alcohol 80 per cent. strong, until it is dissolved, and the solution is then filtered. More or less cochineal is taken according as the color is required to be darker or lighter.

9. *Scarlet Stain for Leather.*

30 grams. (1.05 ozs.) of scarlet berries
are bruised, and dissolved in 120 grammes (4.2 ozs.) of alcohol 80 per cent. strong, and the solution is filtered.

10. *Purple Stain for Leather.*

250 grams. (8.75 ozs.) of Brazil-wood shavings,
or,
60 grams. (2.1 ozs.) of scarlet berries,
are boiled in 1 kilogramme (2.2 lbs.) of water in an earthen pot, or in a bright copper boiler. The decoction is filtered and compounded with a sufficient quantity of fluid chloride of zinc[1] to obtain either a lighter or a darker color.

[1] Chloride of zinc for this purpose is obtained by gradually dissolving 120 grammes (4.2 ozs.) of granulated English zinc in 250 grammes (8.75 ozs.) of nitric acid and filtering the solution.

11. *Crimson Stain.*

A solution of

4 grams. (0.14 oz.) cochineal,
4 grams. (0.14 oz.) cream of tartar,
12 grams. (0.42 oz.) of solution of zinc,

is prepared. The mixture is thoroughly shaken, and the contents of the bottle are exposed to heat for twenty-four hours. Spirit of sal ammoniac is then added in drops until the desired color is obtained.

III. *Black Stains for Wood.*

1. 500 grams. (17.5 ozs.) of Brazil-wood, and
15 grams. (0.525 oz.) of alum,

are boiled for one hour in 1.25 kilogrammes (2.75 lbs.) of water. The colored liquor is then filtered from the boiled Brazil-wood, and applied several times boiling hot to the wood to be stained. This will assume a violet color. This violet color can be easily changed into black by preparing a solution of

60 grams. (2.1 ozs.) of iron-filings, and
30 grams. (1.05 ozs.) of common salt in
500 grams. (17.5 ozs.) of vinegar.

The solution is filtered, and applied to the wood, which will then acquire a beautiful, black color.

2. *Another Receipt.*

250 grams. (8.75 ozs.) of gall-nuts, and
1 kilogram. (2.2 lbs.) of logwood,

are boiled in 1 kilogramme (2.2 lbs.) of rain water

for one hour in a copper boiler. The decoction is then filtered through a cloth, and applied several times while it is still warm to the article of wood to be stained. In this manner, a beautiful black will be obtained.

3. *Runge's Chrome Ink as a Black Stain for Wood.*

This is prepared by dissolving

15 grams. (0.525 oz.) of extract of logwood, in
1 kilogram. (2.2 lbs.) of hot rain water,

and by adding to the lukewarm solution,

1 gram. (0.035 oz.) of chromate of potassa.

When this is applied several times to the article to be stained, a dark-brown color will first be obtained. To change this into a deep chrome-black, the solution of iron-filings, common salt, and vinegar, given under III. 1, is applied to the wood, and the desired color will be produced.

4. *Alizarine ink as a black stain for wood.*

Several coats of this are applied to the wood, but every coat must be thoroughly dry before the other is put on. When the articles are dry the solution of iron-filings, common salt, and vinegar, as given in III. 1, is applied to the wood, and a very durable black will be obtained.

5. *Black Stain for Horn.*

2.50 kilograms (5.5 lbs.) of burned lime
are slaked in a little water so that a powder-like hydrate of lime is obtained ; this is mixed with

1 kilogram. (2.2 lbs.) of minium,
and this mixture is formed into a thick paste with such lye as soap-boilers use having a specific weight of 1.036. The articles of horn are placed in this solution for 24 hours ; they are then taken out, rinsed off with water, dried with a cloth and brushed over with rapeseed oil, and then again rubbed dry.

6. *Finest Black Stain for Horn.*

4 grams. (0.14 oz.) of silver
are dissolved in 60 grammes (2.1 ozs.) of nitric acid (aqua fortis), and this solution is applied several times to the article to be stained, but it is absolutely necessary that the first coat should be entirely dry before another is applied. The articles are then burnished and made bright.

7. *Black Stain for Leather.*

120 grams. (4.2 ozs.) of bruised gall-nuts and
500 grams. (17.5 ozs.) of green nut-shells
are boiled in 750 grams. (26.25 ozs.) of rain water.

When the mixture has boiled for one hour, the liquor is strained through a cloth. The leather to be colored is first stained with the solution of iron-filings, com-

mon salt, and vinegar as given under III. 1, before the above decoction is applied.

According to Herzog a black stain for wood giving to it a color resembling ebony is obtained by treating the wood with two fluids one after the other. The first fluid to be used consists of a very concentrated solution of logwood and to

10 grams. (0.35 oz.) of this fluid are added
0.50 gram. (0.017 oz.) of alum.

The other fluid is obtained by digesting iron-filings in vinegar. After the wood has been dipped in the first, hot fluid, it is allowed to dry, and is then treated with the second fluid, several times if necessary.

IV. *Blue Stains.*

1. A beautiful blue stain is obtained by gradually stirring

15 grams. (0.52 oz.) of finely powdered indigo into

120 grams. (4.2 ozs.) of sulphuric acid of 60 per cent. and by exposing this mixture for 12 hours to a temperature of 25° C. (77° F.). The mass is then poured into 5 to 6 kilogrammes (11 to 13.2 lbs.) of rain water and filtered through felt. This filtered water is applied several times to the wood until the desired color has been obtained. The more the solution is diluted with water the lighter will be the color.

2. *Another Receipt.*

30 grammes (1.05 ozs.) of the finest indigo carmine are dissolved in 250 grammes (8.75 ozs.) of water, and this is applied several times to the articles of wood to be stained. A very fine blue is in this manner obtained.

3. *Blue Stain of Elder-berries for Leather.*

1 kilogramme (2.2 lbs.) of the elder-berries are boiled with 30 grammes (1.05 ozs.) of alum free from iron in 1 kilogramme (2.2 lbs.) of wine vinegar for one hour, and the liquor is then strained through a cloth. On the other hand,

10 grams. (0.35 oz.) of blue vitriol

are dissolved in 50 grammes (1.75 ozs.) of wine-vinegar, and this solution is also filtered.

If leather is to be colored blue, the decoction of elder-berries is applied uniformly with a sponge. When the coating is dry, it is brushed over lightly with the solution of blue vitriol in vinegar.

4. *Blue Stain for Wood.*

100 grams. (3.5 ozs.) of French verdigris

are dissolved in 100 grammes (3.5 ozs.) of urine, and 250 grammes (8.75 ozs.) of wine vinegar. The solution is filtered and applied to the article of wood to be stained.

Then a solution of

60 grams. (2.1 ozs.) of carbonate of potassa in
250 grams. (8.75 ozs.) of rain water

is prepared, and the article colored with the verdigris is brushed over with this solution until the desired blue color makes its appearance.

5. *Blue with Aniline.*

Without doubt the newest processes of staining wood blue, are those with aniline colors. The following colors may be chosen for the staining liquor:—

Bleu de Lyon (reddish blue),
Bleu de Lumiere (pure blue),
Light blue (greenish blue).

These colors are dissolved in the proportion of

1 part of coloring substance to
30 parts of spirit of wine,

and the wood is treated with the solution.

V. *Yellow Stains.*

1. *Yellow Stain for Wood.*

60 grammes (2.1 ozs.) of finely powdered turmeric are digested for several days in 500 grammes (17.5 ozs.) of alcohol, 80 per cent. strong, and then strained through a cloth. This solution is applied to the articles to be stained. When they have become entirely dry, they are burnished and varnished.

2. *Another Receipt.*

15 grammes (0.52 oz.) of nitric acid (aqua fortis) are compounded with 45 grammes (1.57 ozs.) of rain

water, and the article to be stained is brushed over with this. Undiluted nitric acid gives a brownish-yellow color.

3. *Yellow Stain for Horn.*

500 grammes (17.5 ozs.) of alum, free from iron, are dissolved in 2 kilogrammes (4.4 lbs.) of rain water.

The articles of bone, ivory, or horn to be stained are allowed to lie in this for one or two hours. In the mean while

200 grams. (7 ozs.) of yellow berries[1]
are boiled with
120 grams. (4.2 ozs.) of carbonate of potassa in
1 kilogram. (2.2 lbs.) of water,

for one hour, and then strained. The articles stained with alum are placed in this decoction, and allowed to lie in it for one hour. They are then taken out and dried.

4. *Yellow Stain for Leather.*

15 grammes (0.52 oz.) of saffron cut in small pieces, are digested in 60 grammes (2.1 ozs.) of alcohol, 80 per cent. strong, for several days at a

[1] Yellow berries (grains of Avignon) are obtained from a dye-producing Christ-thorn, *Rhamnus infectorius*, a bush which grows in France, Spain, and Italy, and which, according to Linnæus, belongs to the fifth class *Pentantria*, first order *Monogynia*, and to the family of *Rhamneæ juss.*

moderate heat. The solution is filtered, and applied directly to the leather.

5. *Another Receipt.*

500 grammes (17.5 ozs.) of ground yellow wood, or 500 grammes (17.5 ozs.) of birch leaves are boiled for one hour in 1 kilogramme (2.2 lbs.) of vinegar, and the fluid is strained. The articles to be colored are first stained with a solution of

30 grams. (1.05 ozs.) of carbonate of potassa, or
30 grams. (1.05 ozs.) of alum, free from iron, in
1 kilogram. (2.2 lbs.) of rain water,

and are then brought for one hour in contact with the above decoction.

It is best to apply the solution of alum, or carbonate of potassa, with a sponge to the leather, which has first been stretched, and when this has become dry, to apply the coloring liquor also with a sponge.

6. *Bright Yellow Stain for Leather.*

30 grams. (1.05 ozs.) of finely-powdered curcuma, and
15 grams. (0.52 oz.) of gamboge,

are digested at a gentle heat for a few days in 750 grammes (26.25 ozs.) of alcohol, 80 per cent. strong, and the fluid is then filtered. The process is the same as has been indicated above, under 5, either with or without alum, or carbonate of potassa.

Wooden articles are brushed with the solution until the desired yellow color has been produced.

7. *Another Receipt.*

500 grams. (17.5 ozs.) of barberries[1] are boiled in

1 kilogram. (2.2 lbs.) of water,

and the decoction is filtered. In this case, also, a solution of alum or carbonate of potassa in water is used before applying the decoction to the article.

8. *Yellow Stain from Weld (Dyer's Weed).*

500 grams. (17.5 ozs.) of weld[2] are boiled in

1.5 kilograms. (3.3 lbs.) of water

for one hour, and used in the same manner as 7.

9. *Yellow Stain for Wood.*

45 grams. (1.57 ozs.) of carbonate of potassa are dissolved in 120 grams. (4.2 ozs.) of rain water. This solution is poured over

15 grams. (0.52 oz.) of annotto,

and this mixture is allowed to stand for three days in a warm place, being frequently shaken in the mean

[1] Barberries are obtained from the common barberry-bush, *Berberis vulgaris*, which belongs to 6th class *Hexandria*, 1st order *Monogynia*, to the family of *Berberideæ ventenant*, and grows in Europe and Central Asia.

[2] Weld comes from *Reseda luteola*. This plant belongs to the 11th class *Dodecandria*, 3d order *Trigynia*, belongs to the family *Lapparideæ*, and is much cultivated.

while. It is then filtered and 5 grams. (0.175 oz.) of spirit of sal ammoniac are added to it. The stain is now ready, and the articles to be stained will acquire a very beautiful bright yellow color by placing them in it.

10. *Bright Golden-yellow Stain.*

15 grams. (0.52 oz.) of finely powdered madder are digested for twelve hours with 60 grams. (2.1 ozs.) of diluted sulphuric acid,[1] and then filtered through a cloth. The articles to be stained are allowed to remain in this fluid from three to four days, when they will be stained through.

11. *Golden-yellow Stain for Bone and Ivory.*

5 grams. (0.175 oz.) of picric acid are dissolved in
30 grams. (1.05 ozs.) of hot water.

On the other hand,

2 grams (0.07 oz.) of concentrated sulphuric acid are diluted with 10 grams. (0.35 oz.) of hot water, and the freshly smoothed articles are laid in the fluid, and are frequently turned. They are then taken out, dried off, and placed in a solution of picric acid while this is still hot, where they remain until they are uniformly yellow. A lustre is given to them by polishing

[1] Diluted sulphuric acid for this purpose is obtained by compounding 15 grammes (0.52 oz.) of English sulphuric acid with 120 grammes (4.2 ozs.) of rain water.

with soap, water, and fine whiting. (This is a very good method for coloring billiard balls yellow.)

12. *Another Receipt.*

10 grams. (0.35 oz.) of aniline yellow are dissolved in

300 grams. (10.5 ozs.) of spirit of wine.

The wood is brushed over with this solution, or is placed in it. If some aniline red is added to this stain, all shades of color from orange to bright reddish yellow can be obtained.

VI. *Green Stains.*

1. *Green Stain for Wood.*

120 grams. (4.2 ozs.) of purified verdigris are dissolved in 500 grams. (17.5 ozs.) of vinegar.

The hot solution is applied to the articles of wood, which have been previously warmed, until the desired result has been obtained.

2. *Green Stain for Horn, Ivory, and Bone.*

120 grams. (4.2 ozs.) of copper, cut up finely, are gradually dissolved in

375 grams. (13 ozs.) of nitric acid (*aqua fortis*), and the articles to be stained are boiled in this solution until they have assumed a fine green color.

3. *Green Stain for Leather.*

45 grams. (1.57 ozs.) of verdigris, and

15 grams. (0.52 oz.) of sal ammoniac,

are dissolved in 250 grams. (8.75 ozs.) of wine vinegar. If a small quantity of saffron extract is added to this, a yellowish-green color, the so-called parrot-green, is obtained.

4. *Another Receipt.*

If leather is first coated with a solution of Berlin blue, and then with a yellow stain, a beautiful, durable green will also be obtained.

5. *Green Stain for Wood, Horn, Ivory, Bone, and Leather.*

15 grams. (0.52 oz.) of fine indigo carmine are dissolved in 60 grams. (2.1 ozs.) of rain water.

Then—

5 grams. (0.175 ozs.) of pure picric acid are dissolved in 60 grams. (2.1 ozs.) of boiling hot rain water, and both solutions are mixed together. A very beautiful, durable green color will in this manner be obtained, and can be used for the various manipulations.

Only a weak solution of picric acid is required for staining pine wood green.

6. *Another Receipt.*

10 grams. (0.35 ozs.) of aniline green are dissolved in 120 grams. (4.2 ozs.) of spirit of wine, and the wood to be stained is treated with this solution.

All the different shades of green may be produced by adding blue or yellow stain.

VII. *Tortoise-shell Stain for Horn.*

A tough dough is prepared from

500 grams. (17.5 ozs.) of white litharge,

1 kilogram. (2.2 lbs.) of finely powdered unslaked lime,

1.5 kilogram. (3.3 lbs.) of soap-boiler's lye, having a specific weight of 1.036.

The places of the horn which are to become dark are covered with this dough, and the horn is allowed to remain in contact with the dough for about twenty-four hours, until the latter has become entirely dry. The horn is then cleansed with a brush.

VIII. *Brown Stains. For Leather.*

1. 500 grams. (17.5 ozs.) of dried and powdered nut-shells are boiled for one hour in

1500 grams. (52.5 ozs.) of milk of lime, and strained through a cloth. This decoction is applied frequently to the leather.

2. 120 grams. (4.2 ozs.) of ground logwood,

120 grams. (4.2 ozs.) of annotto,

are boiled in 500 grams. (17.5 ozs.) of rain water and a solution of

15 grams. (0.52 oz.) of carbonate of potassa in

75 grams. (2.62 ozs.) of vinegar, is added to the above decoction.

3. A brown stain is also obtained by rubbing together, upon a marble slab,

120 grams. (4.2 ozs.) of umber,
15 grams. (0.52 oz.) of the finest lampblack, in oil, with
500 grams. (17.5 ozs.) of ox-gall.

4. *Hirschberg's Stain for Walnut.*

To give to walnut a dark color resembling rosewood, Hirschberg uses a solution of

5 grams. (0.17 oz.) of bichromate of potassa in
30 grams. (1.05 ozs.) of water.

This solution is applied to the walnut with a sponge, and the wood is then pumiced and polished.

5. *Walnut Stain for Soft Wood.*

By a simple staining furniture of pine or birch wood can be easily made to appear as if it had been veneered with walnut veneer. For this a solution of

90 grams. (3.15 ozs.) of manganate of potassa, and
90 grams. (3.15 ozs.) of sulphate of manganese, in
5 liters (5.25 quarts) of hot water, is made.

This solution is applied to the wood with a brush, and this must be repeated several times. The man ganate of potassa is decomposed when it comes in contact with the woody fibre, and thus a beautiful and very durable walnut color is obtained. If small wooden articles are to be stained in this manner, a very much diluted bath is prepared, the articles are dipped into it and kept there for one to five minutes, according as the color is desired lighter or darker.

IX. *Violet Stain for Leather.*

500 grams. (17.5 ozs.) of Brazil-wood are boiled for one hour in 1.25 grams. (0.44 oz.) of water, and the decoction is then filtered.

Another solution of 120 grams. (4.2 ozs.) of copperas in 250 grams. (8.75 ozs.) of water is prepared, and this is mixed with the decoction of Brazil-wood. Violet stains are also obtained by mixing red and blue stains together.

SECTION III.

Workshop and Tools.

By the workshop of a varnisher or lacquerer we understand a well-lighted, spacious room, which is best located on the ground floor. It should be provided with a coal-stove, and the floor should be either of boards or of asphaltum. Of course it is understood that the room is always kept free from dust, not by sweeping it, but by wiping it up with a wet cloth. If the room were to be swept with a broom, the freshly-lacquered or varnished article would be completely spoiled, as the dust would settle upon the moist coating of lacquer or varnish, and the result would be that the surface would not be smooth.

In the room should be also a large table with drawers, in which the different paint-brushes, varnish-brushes, camels-hair-brushes, pencils, etc., the spatulas

of iron, wood, or bone, the rulers, and paint-boards are kept.

The palettes and brayers, as well as the grinding machine for colors, are kept upon smaller tables.

In a roomy closet provided with lock and key, large and small pots, and earthen and porcelain dishes, are stored, as well as bottles of tin and glass, in which the oils and varnishes to be used are kept. The vessels for cleansing the brushes and those in which they are kept, dust-brush and all such articles, are also kept in the closet.

The room should be further furnished with several wooden horses and trestles, and a so-called drying-oven (lacquering-oven).

Section IV.

Art of Lacquering and Varnishing.

By lacquering is generally understood the art of first applying any desired color to various articles of wood, stone, iron, ivory, horn, leather, clay, sheet-metal, then to rub them, and finally coat them with lac-varnish. In a narrower sense, only coating with lac-varnish is to be understood by lacquering.

General Rules.

As has been already mentioned, articles to be lacquered receive first a ground-color, which is called priming. This ground-color consists of one or more coats of oil-color, according to the nature of the arti-

cle to be lacquered. But the articles must be thoroughly cleansed before this ground-color can be applied. This is done by rubbing them with pumice-stone, by grinding them with water and a stone, or simply by dusting them off with a feather-brush, dust-brush, etc. Every coat of the priming must be thoroughly dry before the second coat is applied, and special care should be had that the priming is done in a place free from dust. When the coat of oil-paint has become dry, it is rubbed with pumice-stone powder and shave-grass (horse-tail), and then cleansed, which is done by washing it with a sponge and clear water.

If the articles are to be decorated, for instance, with drawings, or ornaments in gold, silver, or bronze, this is done after the last priming, and they must also be thoroughly dry before the lacquer is applied. Then the first coat of lacquer is given, and in doing this care must be had not to injure the decorations. When this coat has become *thoroughly hard*, it is gently rubbed with powdered pumice-stone, tripoli, and burnt hartshorn and felt, and then washed off. The second coat is then given. If the lacquering is also to be polished it is, of course, necessary that the last coat of lacquer should be thoroughly dry and hard, so that the polish will show a proper lustre.

We now proceed to the separate labors which have to be performed in lacquering.

1. *Priming.*—This consists of one or more coats of oil-paint, which must be applied according to the nature of the article. But it must be laid down as a

rule that the second coat should be applied in a direction opposite to that of the first; and in regard to articles of wood we must draw attention especially to these rules: that the wood should be thoroughly dry, that the first coat applied should not be too thick, that it is to be applied in the direction of the grain of the wood, and that it should be thoroughly rubbed into the pores of the wood.

2. *Pumicing the Priming.*—This is done with smooth pieces of pumice-stone and water, but for finer articles linseed oil is used instead of water. A great deal of practice is required to do this so that one place does not become deeper than another, and the pumicing must be done not in one direction, but with a circular motion, so that all places are touched uniformly and with equal pressure. When this has been done the article is thoroughly cleaned with a soft sponge and water, and rubbed with a soft chamois skin and then dried. Rubbing with linen rags must be rejected, as no clean ground can be obtained with them.

3. *Laying on the Color.*—This is done with a fine paint-brush, and on finer articles with a camel's-hair brush. The colors used for this purpose must be rubbed very fine, and must be applied very uniformly and not too thickly. To get the layer of color as uniform as possible, it is best to go over it once more with a very fine brush. At the present time a little lac-varnish is mixed with the priming, by which as uniform a coat as possible is obtained. Of course, where more coats than one are to be given, the neces-

sary quantity of paints *for all coats* should be prepared at one time, to avoid the possibility of getting the second somewhat lighter or darker than the first, as otherwise two kinds of ground would be formed in pumicing, by the lower coat, be it darker or lighter, shining through. As has been already mentioned, all the coats must be allowed to become thoroughly dry; then we proceed to

4. *Pumicing the Paint.*—This is done with shave-grass (horse-tail) and pumice-stone. Here it is necessary to proceed with the greatest care, so that all inequalities of surface are removed, but without rubbing through the paint, or else the painting would have to be repeated. When the pumicing is finished, the article to be lacquered is cleansed with water and dried with soft leather. It is then ready for receiving decorations, etc.

5. *Varnishing.*—First of all the room in which this very delicate work is to be done must be entirely free from dust; much moving about in it should not be permitted, and for this reason not many workmen should work in one room, as dust will naturally be raised by their moving to and fro. The varnishes to be used, the oil as well as the volatile varnishes, should be kept in hermetically closed vessels of glass, porcelain, or tin, and should be opened only while they are in use. Either camel's-hair brushes or bristle brushes are used for laying on the varnish. Their sizes must correspond with the articles to be varnished, but they must not be too small, so that the labor may

be accomplished quickly. Brushes which lose bristles when used should be thrown aside. It is best to cleanse the brushes with oil of turpentine after they have been used, and to wrap them up in paper. If a brush is dried up, it is best to lay it aside, though it can be softened with oil of turpentine which has been gently heated, but it never will become as good as before, and, therefore, it should be a guiding rule to cleanse every brush immediately after it has been used.

Varnishing requires a great deal of practice and skill, and therefore general rules only can be laid down in regard to it.

Amongst these it may be especially mentioned that the work should be done quickly, that no place be touched twice, that the varnish always be laid on in one direction, that not too much varnish is taken on the brush at one time, as by doing this uneven places will be formed. Oil-varnish is laid on cold, and in a room which is not heated (of course only during the summer), but volatile varnish is applied, either cold or warm, according as wood, paper, or metal is to be lacquered. In the first case it is laid on cold, in the latter when heated only. The volatile varnish to be used is not placed directly upon the fire, but is put in a tin vessel filled with hot water. Volatile lacquer must be treated with special care, and must be laid on the article to be lacquered, which has first been heated, in a warm room. Care must also be taken not to breathe or blow upon the article, as in such case the varnish

will quickly coagulate, absorb moisture, and turn white.

As has already been mentioned, lac-varnishes must not be laid on too thickly, and under no consideration in a layer of varying thickness, as blisters and wrinkles will be formed, without mentioning the fact that the work will be uneven.

Two coats of oil-varnish and three of volatile varnish are generally sufficient, but if the lacquered articles are to be polished, four coats of oil-varnish and five of volatile varnish will be required. If oil-varnishes are to be polished, they must be pumiced after each coat has been applied.

It must further be accepted as a rule that lacquering in the open air should be done only on clear days, and, of course, not in the sun. Fog or damp air causes the coat of lacquer to turn white, or at least gives to it a dull look, and the sun will blister lacquer which is not completely dry.

6. *Pumicing Lac-Varnishes.*—The object of pumicing lac-varnishes is to remove any inequalities of surface which may have been formed. It will easily be understood that this is a labor requiring special skill. But pumicing lac-varnishes cannot be omitted, under any consideration, as the lacquered article would not look well. Just the reverse of this, the lacquered article must be pumiced so smooth that its surface shines like a mirror.

7. *Polishing Lac-Varnishes.*—If fat varnishes are to be polished, they must first be pumiced with pum-

ice-stone powdered as fine as possible. The layers of lacquer are then rubbed with burnt hartshorn, or burned and prepared oyster-shells, mixed with water, until the hartshorn or oyster-shells have become dry, and the lacquered article shows lustre. The rubbing is done with a small pad. When this operation is finished, some deer-suet is taken upon the pad and the article rubbed with this, and then some hair-powder is used, which will remove the grease left from the suet. The article will then have acquired a beautiful lustre. But special care must be taken to thoroughly examine the powdered hartshorn, or oyster-shells, and to separate any particles of sand which may have been accidentally mixed with it, as these would do great injury to the work by scratching it.

Volatile lac-varnishes are polished in the same manner as described above.

Materials Used for Pumicing in the Art of Lacquering.

These materials are pumice-stone in pieces, so-called raw pumice-stone, very finely powdered, and washed pumice-stone, tripoli, emery, animal charcoal, prepared hartshorn, oyster-shells, whiting, shave-grass (horse-tail), felt, woollen cloth, leather, and linen.

Varnishing of Wooden Articles, Carriages, and Furniture.

It is necessary to accurately observe the following rules in varnishing:—

1. *Examination of the Article.*—The carriage or wagon, which is received from the builder, is thoroughly examined, and the first labor of the varnisher is to be done, in case any cracks or flaws are found in the body parts.

The varnisher prepares hot glue, takes finely picked flax, dips this into the glue, and fills the cracks with it. It is allowed to dry thoroughly, and all the superfluous glue is then removed.

When this operation is finished, and the respective parts of the body have been smoothed, the next work is proceeded with.

2. *Soaking with Linseed-Oil Varnish.*—This is done to prevent moisture from penetrating. A uniform layer of linseed-oil varnish is applied, and as soon as the first coat has become thoroughly dry the second coat is laid on.

3. *Puttying* (filling up).—It may happen that depressions are found in the panels, and to remove them they are filled up with putty. When the putty has become perfectly dry, the guide coat is laid on.

4. *Laying on the Priming Coat.*—The so-called priming coat consists of a mixture of finely rubbed ochre, finely rubbed umber, linseed oil, oil of turpentine, white litharge, and copal varnish in such proportions that the entire mass can be easily applied without being too thin. This priming coat is then laid on the body of the carriage. The first coat, when dry, is succeeded by six or seven other coats, but the one coat must always be entirely dry before the next is applied.

The coat may be considered dry when the finger-nail leaves no impression. Finely powdered pumice-stone is generally mixed with the last coat of the priming coat. This causes the coat to be granulated, and facilitates the pumicing of the article.

Then follows:—

5. *Pumicing the Ground.*—This is done with porous and fibrous pumice-stone, which is ground smooth on one side. Several pieces, some round and some square, are required for this. Attention must be paid that the piece of pumice-stone which is used for pumicing is always sharp enough. If it does not take hold, it is rubbed with another piece of pumice-stone until it has become sharp enough.

The greatest care must be observed in pumicing the panels that not a single place remains untouched; for this reason the pumiced place must be frequently washed off with clean water, so as to be able to observe whether it has been sufficiently pumiced, or whether the labor has to be continued. The ground should become as smooth as glass, and after it has been washed off it should be thoroughly dried with chamois skin.

6. *Ground Coat (Disguise Coat) and its Application.*—This is composed of white lead, with a mixture of linseed-oil varnish and oil of turpentine, a small quantity of very fine white litharge and amber lacquer.

One or two coats of this paint are given, but it must never be laid on too thick. Here, also, the first coat must be thoroughly dry before the second is laid on.

7. *Pumicing the Disguise Coat.*—This is accomplished best by using very finely powdered pumice-stone and a piece of felt or cloth and water. Pumicing is continued until no more inequalities are observed in the surface, and the places are washed off with a sponge, and carefully dried.

8. *Laying on the Principal Color.*—The color which is to be given to the carriage must be very finely rubbed together with a mixture of linseed-oil varnish and turpentine, the siccative is added, and must be always protected from dust. When it is to be used either amber lac varnish or copal lac varnish is added. Of this three to four coats are given. But two, or, at the utmost, three coats are sufficient, if the paint is to receive a glazing. Two or three coats of glazing are laid on when the coats of paint have become thoroughly dry. The glazing used for this purpose must be very finely rubbed with fat oil lac varnish, and allowed to settle, so that the upper part forms a colored varnish. Special care must be observed in laying on the glazings uniformly, and if this is done, they stand like a mirror upon the paint when they have become dry.

9. *Pumicing the Principal Paint.*—Shave-grass (horse-tail) and very finely powdered pumice-stone are used for this purpose, and felt and powdered pumice-stone later on. The purpose of doing this is to remove all inequalities of surface which may have been formed. When all the parts have been pumiced, they

are washed with clean water, and carefully dried with chamois skin.

The next work is—

10. *Decorating and Striping.*—Generally this consists only of narrower or wider stripes of different colors, gold borders, and coats of arms. The paint used for striping is generally rubbed together with linseed oil varnish and oil of turpentine, and compounded with a small quantity of finely powdered sugar of lead. It is generally laid on with the so-called drawing brush, and requires great skill and a sure hand.

For coats of arms and gold ground the finest yellow ochre is rubbed together with a little white lead in old but entirely clear linseed oil varnish, which must not be of too great consistency. If this mixture is applied, and allowed to dry for eighteen to twenty hours, the coating is ready for the gold.

All the decorations must be smooth and even, or they will suffer injury when the varnish is pumiced.

11. *Laying on the Varnish.*—As soon as the stripes and other decorations are dry, they are wiped off with a moist chamois skin to remove any dust which may have settled upon them, and a coat of varnish is then quickly laid on. The coat is repeated twice or three times. When the varnish has become somewhat dry in the shop, the carriage is brought into the air and sun, but it must be frequently turned about so that it will dry uniformly.

When the last coat of varnish has become entirely dry—

12. *Pumicing and Polishing* is commenced. This is done with very finely powdered pumice-stone, and a piece of felt or chamois-skin. When this has been done—

13. *The Last Coat of Varnish* is laid on with quick, uniform strokes. This last coat is not pumiced.

Varnishing of Furniture, Cases, Instruments, etc.

1. *Wooden Articles to be Varnished.*—The principal rule for these is that the respective articles are pumiced and thoroughly smoothed; this may be done with pumice-stone and shave-grass (horse-tail). Then all the defective places are puttied up with a putty consisting of sawdust and glue, and what is superfluous of this is carefully removed. Then the scraper is used, and when the work has been done thoroughly, the surface is rubbed smooth with a suitable piece of pumice-stone. It is advisable to repeat the pumicing with powdered pumice-stone to prevent any place from remaining untouched, and then to go over it with shave-grass, which will make the respective places entirely smooth.—

When the ground has been pumiced smooth, the following has to be taken into consideration:—

a. If it is desired to preserve the natural color of the wood, one or more coats of lac-varnish are laid on at once; the coat of varnish is either left as it is, or

it is pumiced, and the wood receives another coat of varnish, and this last coat is polished.

b. If the articles are to be stained, one of the stains, the receipts of which have been given upon preceding pages, is used for the purpose. When the stain is dry the articles receive from four to five coats of colorless varnish, and the work is finished by polishing the last coat.

c. Wooden articles may also first be coated with glue, or linseed-oil varnish, and can then be varnished with the various colored varnishes.

d. The articles to be varnished are veined, either with color prepared with size (glue-water), beer, or vinegar, or with linseed-oil varnish. These are rubbed together with a yellow, reddish-brown, brown, or other pigment, according to the natural color of the wood which is to be imitated. When the work of sizing the article is finished and the coat is entirely dry, the articles are pumiced and receive then three or four coats of lac-varnish.

e. Sizing for mixing the color is best prepared by boiling 60 grammes (2.1 ozs.) of glue in 500 grammes (17.5 ozs.) of water, and by adding a small quantity of a decoction of garlic or wormwood to it. The article to be varnished receives three or four coats of this. It is claimed that the decoction of garlic or wormwood will prevent the wood-worm from attacking the articles. When the coat of sizing has become entirely dry it is rubbed off with shave-grass. The so-called chalk ground is obtained by mixing very fine whiting

with the sizing and by laying three or four coats of this on the article. The ground is pumiced with pumice-stone and water. When all has been pumiced smooth and thoroughly cleansed, three or four coats of paint are laid on, and when this is entirely dry it is rubbed with shave-grass, cleansed, and varnished with volatile lac-varnish.

f. The priming coat of oil-paint is put on the articles to be varnished in the following manner: The articles are first coated with hot, well-boiled, linseed-oil varnish; they receive then a coat of a mixture of ochre and white lead, rubbed together with linseed-oil varnish, or still better, with siccative, and when this is dry, are pumiced with pumice-stone and water. As soon as all places have been uniformly pumiced, a coat of the color which the article is to have is laid on. For this purpose it is best to incorporate the pigment in as fine a state as possible with good linseed-oil varnish, to reduce it with oil of turpentine to the desired consistency, to compound it with a small quantity of copal varnish, or amber varnish, and then give a coat of it to the article in question.

When dry it is pumiced with powdered pumice-stone and felt, and then the varnish is laid on. Thicker or thinner lac-varnish is used for this purpose according to the state of the temperature.

Therefore thinner varnish must be used when the air is cold, and thicker varnish when it is warm.

Veining with oil-paint is done in the following manner: The article receives first one or two priming

coats of oil-paint; this, when dry, is pumiced, and the veining is then done, either with oil-paint or water-color. The first process is easier than the last. The kinds of wood principally imitated are oak, curled maple, walnut, rosewood, and mahogany, and, of course, the ground color to be used depends on the kind of wood to be imitated. These are—

for oak, white lead and ochre;

for curled maple, white lead and a small quantity of ochre;

for walnut, white lead and umber;

for rosewood and mahogany, burnt ochre and colcothar (Indian red).

The water colors for veining are prepared by mixing—

for oak, umber;

for curled maple, burnt sienna;

for walnut, umber;

for rosewood, burnt sienna and umber;

for mahogany, sienna, with a little red,

with water, vinegar, or beer, and they are then laid on according to the rules of the art. The veining itself is done with a brush or sponge, wooden, horn, or leather combs, and in modern times also with veining rollers made of leather or rubber and provided with the pattern of the texture of the wood; quills and even the fingers are also employed for the purpose. The lac-varnish is laid on as soon as the veined ground is dry and has been pumiced. Usually two

coats are given, but the second should never be laid on before the first is entirely dry.

If the veining is to be done with oil-paint, a priming coat of water-color is first laid on, and this is rubbed in with linseed-oil varnish as soon as it has become dry. The veining is done with a camels-hair brush, and the above mentioned colors mixed with linseed-oil varnish. The work is glazed as soon as the veining is dry. This is done with umber, sienna, crimson lacquer, or even carmine lacquer, for very fine articles. The articles are then varnished, but not before the glazing is dry.

Articles of Tin and Metal which are to be Lacquered.

The lacquering of tin and metals differs from that of wood. The first require far fatter lac-varnishes than the latter. They are dried in especially constructed ovens (lacquering ovens).

The usually *rough articles of tin* must be thoroughly smoothed and pumiced before they can be lacquered, when they receive a coat of linseed-oil varnish, and are thoroughly dried by a strong heat. They then receive four or five primary coats, are again thoroughly dried, and then pumiced with pumice-stone and water until the surface is as smooth as a mirror. When these important operations have been finished the principal color is laid on. This is rubbed together with linseed-oil varnish and oil of turpentine, and compounded with copal varnish. The articles receive at least three to four coats of this, but every coat

must be thoroughly dry before the next one is laid on. When the last coat has become as hard as stone the article is pumiced with powdered pumice-stone and shave-grass, the various decorations are put on and allowed to dry, and the article is then varnished with copal lacquer. When this coat of varnish is dry the article may be pumiced with powdered pumice-stone and felt, it is then thoroughly cleansed and carefully dried, and finally receives one or two coats of varnish. It is absolutely necessary that all the described operations should be carried on with the greatest care.

What has been said of tin-ware applies in general also *to articles of iron and steel*, only they require less preparation. When they are ground smooth and polished, it is only necessary to give them a coat of oil-varnish, which is allowed to dry hard, and then the same process is carried on as has been described for tin-ware.

Articles of copper, brass and zinc require a fat, pliant lac-varnish, and specially careful treatment. As most of these articles are soldered and possess more or less fatty matter, the first care must be to free them from this. This is done by thoroughly rubbing the articles with sawdust. They are then cleansed and treated with fat and well-drying paints and varnishes, and dried at a moderate degree of heat. Pumicing and cleansing are done in the same manner as has been described for tin-ware.

The colors mostly used in lacquering the above named wares are—

1. *Black.*—This color is produced either by giving the article a coat of fine calcined lampblack mixed with linseed-oil varnish, or by giving it at once a coat of asphaltum varnish. For common articles the ordinary asphaltum varnish may also be used to advantage upon iron, copper, zinc, etc. Both methods are good, and the coats dry quickly.

2. *Brown* is produced by laying on a priming coat of Venetian red compounded with a small quantity of calcined lampblack. When dry it receives a coat of glazing.

3. *Red.*—A mixture of cinnabar, linseed-oil varnish and oil of turpentine, is prepared for this, and compounded with a small quantity of copal varnish. The article receives from three to four coats of this, is thoroughly dried, and then glazed.

The glazing is prepared by rubbing fine carmine-lacquer with linseed-oil varnish and oil of turpentine, and by compounding this with some copal varnish. This is allowed to stand quietly for a few days. The thin part is then poured off from the sediment, and the painted articles are coated quickly and uniformly. Usually two or three coats are required according as the color is to be light or dark. Strong heat must be used for drying the articles, as the glazing is difficult to dry. When the glazing is thoroughly dry it is pumiced and then varnished.

4. *Green* is produced with mineral green. The treatment is the same as given for red, only green is frequently mixed with yellow and white. The articles

to be lacquered receive first a white priming coat. Dark green is prepared with green cinnabar and glazed with verdigris. This color should *not* be exposed to a great heat.

5. *Yellow, Chamois.*—By chamois-yellow we understand a mixture of white, yellow, and red. Chrome-yellow also does excellent service for yellow. Two or three coats are sufficient.

6. *Blue.*—A mixture of Paris blue and white, or ultramarine and white, is used for a blue priming coat, according as the color is to be light or dark. It is glazed with either Paris blue, ultramarine, or cobalt blue (Thenard's blue).

Other colors are treated in the same manner. A few coats are generally sufficient for covering, and it is then only necessary to lay on the lacquer.

Marbled ground is produced by pumicing the articles, which have first received a black priming, by rubbing them with oil of turpentine, and exposing them to heat. Then a sharply cut bristle brush is soaked with oil of turpentine, and the hot articles are sprinkled with it. It is advisable to hold the articles at some distance to prevent the fine drops from falling upon them. The drops falling upon the article scatter and form a ring on the edge. Gold or silver bronze is laid upon these rings before they become entirely dry. What is superfluous is rubbed off after they have become dry.

Tortoise-shell ground is produced by giving the article a one-colored ground of cinnabar, or any other

fine brown lac-color. When this coat is dry it is pumiced and glazed with carmine-lacquer. The following method is then observed: The wick of an oil-lamp is screwed up higher than usual, so that it commences to soot, and more or less dark places are produced upon the still wet glazing by holding the article over the wick of the lamp and turning it to and fro. When the desired places have been produced in this manner, pumicing is commenced, and the article is then varnished.

Rosewood ground is imitated by giving the article, upon which the ground is to be imitated, a priming coat of calcined lampblack. This is allowed to become thoroughly dry, and is then pumiced. On the other hand a paint of Venetian red and carmine-lacquer, or cinnabar and carmine-lacquer, is prepared with linseed-oil varnish, and the article is veined with a brush according to a sample of a polished piece of rosewood. When this is dry it is glazed with carmine-lacquer, varnished and pumiced.

Decorations with Copperplates and Lithographs.—The apparatus consists of a plate, which is etched for reprinting. When the apparatus is prepared, the following method is observed:—

First a printer's varnish of linseed oil is prepared, which is mixed with the so-called Frankfort black. The varnish must possess great consistency. The plate is heated and some of the ink is put uniformly upon the etched parts with the finger; the greater part of the ink is wiped off, and the plate is cleansed

with lye. When this has been done the plate is brought into the press, a previously moistened paper is laid upon it, this is covered with a cloth folded several times, and then drawn through the press. The paper is then carefully removed, moistened with water, and laid upon the article. The impression of the copperplate is imprinted upon the article by a small roller covered with cloth, and the paper is then removed.

The same manipulation is used for *lithographs*.

Bronze-painting is done with metal-dust, genuine gold leaf, party-gold, silver bronze, and gold bronze, mostly upon black ground. Parisian camels-hair pencils are used for the purpose ; the bronze is rubbed in with a piece of felt upon the previously prepared ornamentation. Patterns cut out of oiled paper are used for the decorations. Genuine leaf gold is laid upon the still moist varnished places. All these operations require a great deal of skill, and this the workman can only acquire by constant practice.

Lacquering of Leather differs essentially from that of tin-ware and articles of metal. One of the main points is to use a pliant lacquer which will stand being bent in any way, will neither break off nor crack, and yet possess the necessary degree of hardness.

The outside of the leather to be varnished must have been well finished and rubbed with train oil. It is then stretched upon a frame, is somewhat moistened

and pumiced, and smoothed with a piece of pumice-stone and with powdered pumice-stone.

When the leather is dry a coat of varnish, made of linseed oil, is laid on. The manner of preparing this lacquer, which is generally done by the lacquerer himself, has been fully described under "blue lacquer," in the appendix to the first part of this work.

Simple Process of Removing a coat of Lacquer, etc., from Tinned Metal Plate.

BY D. H. EMSMANN, OF STETTIN.

About twenty-five years ago I accidentally brought a lacquered tin box in contact with leather through which mercury had been pressed, and found, to my surprise, that the lacquered surface of the box came off in its entirety in the form of a delicate leaf. I was sorry that I had damaged the beautifully ornamented box, but as it had been already injured, I experimented also with the remaining surface, and succeeded in removing everywhere the coat of lacquer without tearing it.

The explanation of this phenomenon was simple. The box was made of tinned sheet-iron, and the coat of lacquer had been partly broken off on the edges; the mercury remaining on the leather had formed an amalgam with the tin; a fluid layer had been formed between the surface of the iron, and in consequence of this the leaf of lacquer floating so to say upon the fluid, could be removed with the greatest ease.

The question now arose, whether this phenomenon could be used to advantage in any manner, and several experiments were made for this purpose. I painted tinned sheet iron with linseed-oil varnish, such as is used for lacquering, and in doing this I handled the brush always in one direction. When this coat of varnish had become dry, in a few days I laid on a second in a direction crossing the first coat at a right angle. When this coat had become dry a cut was made with a knife through the varnish down to the tin, and some mercury was dropped upon this; the entire layer of varnish came off, and showed a parchment-like, smooth surface on the side which had touched the tin.

When the mercury had evaporated I again put a coat of linseed-oil varnish on the same tin, and repeated the operation in the above described manner until a layer about one millimeter (0.039 inch) thick had been formed. This required quite a considerable time on account of the varnish drying but slowly. I obtained, however, a plate like strong leather, with a surface as smooth as a mirror.

From the obtained leather I cut rectangular triangles and rulers for mathematical instrument cases. But as these were not very solid, but rather brittle, I stretched a sheet of paper over a frame and coated it repeatedly on both sides in the above mentioned manner, and obtained in half the time sheets of any desired thickness, which, on account of the inclosed paper,

proved to be more suitable for the indicated purpose, but had not so smooth a surface.

This matter may now be inquired into further, as by this short statement I only intend to incite to further researches.

Very likely leaves of any desired size and thickness and of various substances can be produced in this manner, which may prove especially useful for certain purposes. Paper covered on both sides with a layer of linseed-oil varnish, and then coated with size, answers all the purposes of parchment. It is possible that a substance might in this manner be prepared which, in many cases, could be used as a substitute for leather.

APPENDIX.

JAPANESE AND CHINESE LACQUERS.

Although, on account of their costliness, it is not very likely that these lacquers will ever come into extensive use in our industry, yet for the sake of completeness we will give in the following pages a short description of the products which give such prominence to Japanese lacquered articles.

The Japanese lacquers are purely natural products, and are obtained from the varnish tree (*Vernix* or *Rhus vernicifera*), a kind of sumac, indigenous in Japan as well as in some parts of China.

A larger or smaller number of horizontal incisions, 6 to 9 centimeters (2 to 3.5 inches) long, and 1 centimeter (0.39 inch) deep are made with an especial instrument in the trunks, which are generally about as thick as an arm, and the lateral branches of the tree. These incisions are then made somewhat deeper with a kind of knife, and in the course of three or four days a clear, thick, resinous juice, mixed with some milky matter, commences to exude from them.

This juice is removed from time to time with a small tool shaped like a lancet, is put in small cans or barrels, and thus brought into use.

The juice in a fresh state is yellow to grayish-white and viscid, but on exposure to the air soon becomes brown, then black and very hard. The lacquer obtained from the branches of the tree is valued far higher than that from the trunk, as it becomes a great deal harder than the latter. The lacquer is graded into several qualities by keeping it for some time in well-closed vessels, and by afterwards taking off the upper layer, which has in the mean while become better. Lacquer which has become too thick is reduced with one-fifth of its weight of sesame oil. The entirely black lacquer is prepared in the open air by stirring the fresh juice (which shows poisonous properties[1]) for two or three days, and by adding water containing iron.

The only treatment which this invaluable natural product, which the Japanese know how to make of excellent service to them, undergoes, is to press it through a peculiar, extraordinarily strong, but at the same time very thin paper, to free it from the small impurities.

The lacquers are either used with or without an addition of mineral pigments, such as cinnabar, Berlin blue, verdigris, chrome yellow, etc.

There is a great number of varieties, and these are known by the following names:—

Ordinary lacquer,
Common lacquer,
Natural lacquer,
Yoshino lacquer,
Shiun-Kei lacquer,

[1] Many people become sick from merely inhaling the vapors of this juice.

Seshimo (ground) lacquer,
Djotame (brown) lacquer, I. quality,
Tschiutame (brown) lacquer, II. quality,
Djohana (dark) lacquer, I. quality,
Tschiuhana lacquer, II. quality,
Hakushita (gilders') lacquer,
Roiro (best black) lacquer,
Nakanuri lacquer (for laying on ground),
Nuriate (dark) lacquer,
Kurodame (dark brown) lacquer,
Djo-tshiu (ordinary dark) lacquer,
Namitame (common brown) lacquer,
Nashiji (very finest, transparent) lacquer.
Lacquer mixed with yellow pigment,
Lacquer mixed with cinnabar (three qualities),
Ordinary red lacquer,
Lacquer mixed with Berlin blue.

The following are used as pigments: cinnabar, minium, Berlin blue, verdigris, red ochre, chrome yellow, Djino-Ko meal. The following are used for laying on under the lacquer: a paint made from *comelina communis*, Dutch gold dust, false green gold dust, silver dust, copper dust, genuine gold dust, imitation gold and silver leaf, tinfoil, and gold and silver leaf cut into small pieces.

The following articles are used as aids in lacquering: pulverized haliotis shell, powdered charcoal, powdered charcoal made from magnolia wood for pumicing and polishing, powdered hartshorn, menoko, hemp finely cut.

Further, for lacquering itself: wooden spatulas, and different sizes of broad brushes, made of stiff, short bristles.

Baron von Ransonnet gives the following account of the application of Japanese varnishes :—

The articles to be varnished are generally made of wood, and if they are constructed of several pieces are usually pasted over with paper or cloth, but the joints are then plastered over with a mixture of burnt earth, and the so-called Wantan-goschi (Seshime) lacquer. This operation is repeated several times, but only at intervals of at least one day, and the surface is carefully pumiced every time until the form of the article leaves nothing more to be desired. Only when this is entirely satisfactory, pure lacquer is laid on the article with a flat brush of stiff, short bristles. On account of dust the articles are dried in closed boxes. It is a remarkable thing that the lacquer dries especially quick in a moist atmosphere. When the first layer of lacquer is dry, which may be the case in twenty-four hours, the surface is rubbed with wet charcoal in a similar manner as we use pumice-stone.

Articles for the Japanese market are treated far more carefully than those for export.

When the article is to be ornamented with gold decorations, the drawing is first made with white chalk, the ornamentation is then laid on more or less thick with a mixture of Wantan-goschi lacquer and yellow clay, and for very superior work with a dough formed therefrom, and when the painting is half dry it is coated with fine gold dust, laid on with raw cotton. If the gold is to be durable, thin layers of reddish lacquer and gold are laid on three times over these ground layers. A more or less fine or granular appearance is thereby given to the gold, or different shades to its color. When a good gold lacquer is used, the ornamentation is, strictly speaking, a

kind of relief, which rises above the black or red ground, but frequently also above the ground of the same color on account of its form alone.

There are in Japan numerous fluid lacquers of different qualities, which are called "Uruschi," and these are usually brought into the market in small round wooden boxes of about 8 centimeters (3 inches) in diameter, and protected from dust and drying out by paper floating on the top. Seshime lacquer is the most solid of all varieties; it is used for gluing, for manufacturing paste, and finally for ground for laying on paint. The Japanese pound of this lacquer costs 7 marks ($1.68).

But the most expensive of all varieties is the lacquer called "Nashigi," which is used for the last outer coat. When fresh it has a gray color, but this soon changes into black on exposure to the air. The Japanese pound costs 12 marks ($2.88).

It is self-evident that the costliness of the fluid lacquer alone must make all lacquered articles dear. Besides the quantity of gold used is often considerable, and finally it frequently requires several years to carry out the decoration of larger articles with regular lacquered paintings. The fine gold lacquer is also the most costly the Japanese possess, and many articles are paid for with nearly their weight in gold, a price which few connoisseurs in Europe would be willing to give.

The art of the so-called old lacquer is very simple, and not lost, by any means, as many believe; only a poorer quality has come into use, which did not formerly exist to such a large degree. But if in modern times the quantity of good lacquer which is produced has decreased, the use of lacquer has become far more general.

The few articles of furniture of the Japanese, from the throne of the mikado covered with gold, to the small dining table from which the laborer eats his frugal meal, are all lacquered, yea, even the bowls in which the hot soups, the rice, and other numerous dishes of the rich are served, consist mostly of wood coated with lacquer.

Pleasing appearance, lightness, cleanliness, small power of conducting heat, and finally extraordinary durability, have secured to the Japanese lacquer its general use in Japan.

It has been several times tried to introduce the manufacture of Japanese lacquers into Europe, but without any success, as all experiments made with them have failed on account of their drying too slowly. The lacquer requires in our climate fourteen days and even more to become dry, a time in which even the most skilful and patient lacquerer would despair of keeping dust from the work, even if he should use all means of protecting it.

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